Hall Ticket Number:

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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. (CBCS : Mech. Engg.) I-Semester Make up Examinations, March-2017

(Advanced Design & Manufacturing)

Finite Element Techniques

Time: **3** hours Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

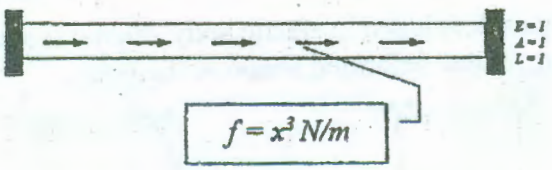
Part-A (10 × 2 = 20 Marks)

1. Name two methods of boundary treatments in FEM.
2. What are the advantages of quadratic interpolation over linear interpolation in FE Modeling?
3. Establish the relationship between stiffness matrices of truss and bar element.
4. Derive the expression for vertical displacement of beam element in the form of $V = N_1q_1 + N_2q_2 + N_3q_3 + N_4q_4$.
5. What is the significance of Jacobian [J] in Finite Element formulation of 2D and 3D problems?
6. Give one example of adopting Numerical integration in evaluating various element matrices in FEM.
7. Derive conductance matrix $[k_T]$ for 1D Linear heat transfer element.
8. Distinguish between lumped mass matrix and consistent mass matrix in FEM dynamics.
9. Sketch Tetrahedral element and state its shape functions in natural coordinate system.
10. What do you understand by velocity potential in an incompressible fluid flow?

Part-B (5 × 10 = 50 Marks)

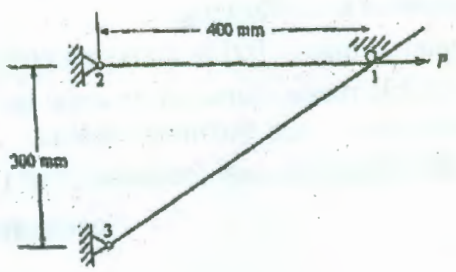
11. a) What are various approximate methods in FEM? [2]

    b) An axial bar with variable traction force $f(x) = x^3$ is shown below. Discretize it in to two linear elements and find nodal displacements and elemental stresses. For simplicity, Take E=1, A=1 and L=1. [8]



12. a) Sketch and describe Hermit shape functions for a quadratic beam element. [4]

    b) A two member truss with load P=8000N is shown below. Member 1-3 was manufactured to be 505mm long instead of 500mm. However it was forced in to place. Determine the stresses in the members of truss. For each member, take cross sectional area as 750mm^2 and youngs modulus as 200GPa. [6]



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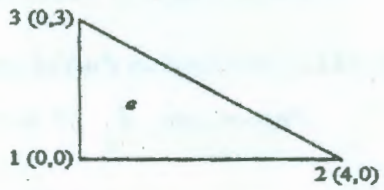
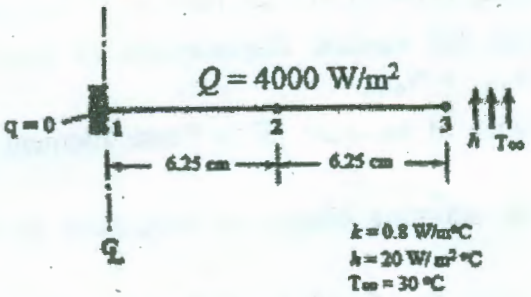
13. a) Describe the characteristics of 2D– iso-parametric element. [5]

b) A CST element is shown below. The element is subjected to a body force $f = x^3$ N/m^3. Find the nodal force vector {F}. Take element thickness: 1 [5]



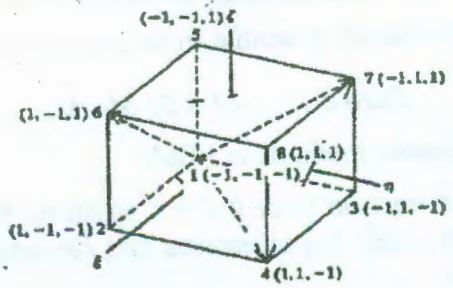
14. a) State the general boundary conditions imposed in heat transfer problems. [2]

b) Heat is generated in slab of 25 mm thickness. It is elementised with two linear 1D elements as shown in figure given below. One face is insulated and other face exposed to ambient. Determine nodal temperature vector. [8]

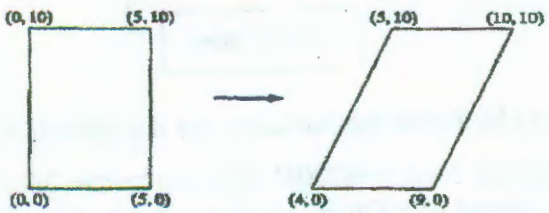


15. a) State strain –displacement relations in a thin metal plate under pure bending condition. [4]

b) Formulate the shape functions for a cube element shown below: $Q = 4000$ W/m^2 [6]



16. a) Determine the strains developed in elastic body when it is strained. The following figures show the undeformed and deformed shape of the body. [5]



b) Sketch beam Element with DOFs and derive Stiffness matrix. [5]

17. Answer any *two* of the following:

a) Derive material matrix [D] in Axisymmetric problems. [5]

b) Sketch possible mode shapes of an axial bar with fixed ends. Also determine its eigen value. Take Mass: 1Kg, Stiffness: 1kN/m. [5]

c) Describe the Finite Element formulation of 1D incompressible flow in small diameter tube. [5]