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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (2012 Batch) (Sem.–6)

FINITE ELEMENT METHODS

Subject Code : ASPE-313

M.Code : 72458

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.
4. Assume suitably missing data if any.

SECTION-A

1. Answer briefly :

a. Write the expression of six strain components in terms of displacements.

b. Differentiate between natural and Cartesian coordinate systems.

c. Explain the kinematically admissible displacement field term as being used in FEM.

d. Explain plain stress condition with one example.

e. Draw eight noded quadrilateral element in Cartesian and natural coordinate systems.

f. Explain Lagrange's shape functions/elements.

g. What is carried out in the processing module of FEM software?

h. What is super-parametric type of Finite Element formulation?

i. Write the equation of 2-D heat conduction problem in terms of temperature (T), thermal conductivity (k) and heat source/sink (Q).

j. Differentiate between complex and multiplex elements with examples.

SECTION-B

2. Explain the principle of minimum potential energy and virtual work with their relevant equations.

3. Derive the transformation matrix for a 2-D truss element which transforms elemental local displacement to elemental global displacement.

4. Explain convergence in reference to Finite Element Method. Also explain the different conditions to achieve the same.

5. Derive the stress-strain matrix for plane stress conditions from the basic concept.

6. For 1-D bar element, transformation is given as $\xi = \left(\frac{2}{x_2 - x_1}(x - x_1) - 1 \right)$ which is used to relate x and ξ Let the displacement field is interpolated as $u(\xi) = N_1 q_1 + N_2 q_2$ where $N_1 = \cos\left(\frac{\pi(1+\xi)}{4}\right)$ and $N_2 = \cos\left(\frac{\pi(1-\xi)}{4}\right)$. Plot the shape functions and develop the strain-displacement matrix. Also develop elemental matrix (you need not to evaluate the integrals).

SECTION-C

7. Explain the Finite Element modeling and shape function for linear interpolation of temperature field (1-D heat transfer element).

8. For the two-bar truss as shown in Fig. 1, determine the displacement of node 1. Assume for both members E = 70 GPa and Area = 200 mm^2.Assume $k = \frac{A_e E_e}{L_e} \begin{bmatrix} l^2 & lm & -l^2 & -lm \\ lm & m^2 & -lm & -m^2 \\ -l^2 & -lm & l^2 & lm \\ -lm & -m^2 & lm & m^2 \end{bmatrix}$ where l and m have usual meanings.

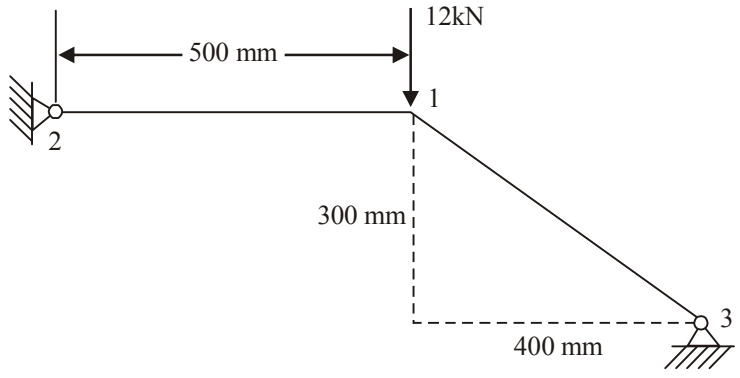

Fig. 1

9. A Constant Strain Triangle (CST) element is shown in **Fig. 2.** The element is subjected to a body force $f_x = x^2$ N/cm^3. Determine the nodal force vector due to the body force. Assume element thickness as 1 cm. The coordinates in the **Fig. 2** are given in cm.

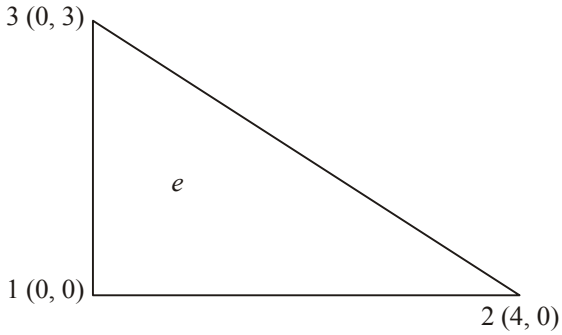

Fig. 2

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.