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**BIMEE-013**

# B.Tech. MECHANICAL ENGINEERING (BTMEVI)

## Term-End Examination

01645

## December, 2014

## BIMEE-013 : FINITE ELEMENT METHODS

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *All questions carry equal marks. Attempt any* ***five*** *questions. Standard notations have usual meaning.*

**1.** (a) How would you formulate a frame element that would be able to model a buckling problem ? Explain. 7

(b) Define the following properties of an element : 7

(i) Dimensionality

(ii) Nodal points

(iii) Geometry

(iv) Degrees of freedom

2. Dashed lines shown in Figure 1 represents independent displacement modes of a four-node rectangular element having two displacement degrees of freedom per node. Which of these nodes are associated with strain energy in the element and which are not ? Answer for each of the following situations :

(a) Strain energy is integrated analytically

(b) Strain energy is integrated by one Gauss point *14*

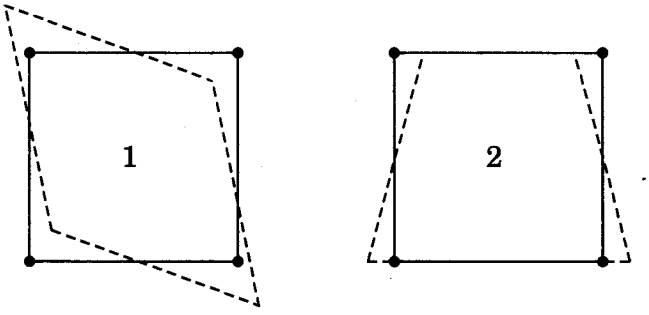


*Figure 1*

3. (a) Discuss what are Iso-Parametric elements. Describe their features and characteristics. *7*

(b) Define shape function and describe its characteristics. Discuss why polynomials are generally used as shape functions. *7*

4. (a) Define internal and external indeterminacies. Write the formulae for degree of indeterminacy for a 2D truss. *7*

(b) Describe in brief any ***two*** of the following : 7

(i) Rayleigh-Ritz method

(ii) h and p versions of finite element method

(iii) difference between static and dynamic analysis.

**5.** A circular bar of uniform cross-section A, length L, Young's Modulus E and density $\rho$ is vertically suspended under its own weight. Using four element model, find the state of deformation and strain under its own weight. *14*

**6.** Estimate the deflection in a steel frame as shown in the Figure 2. *14*

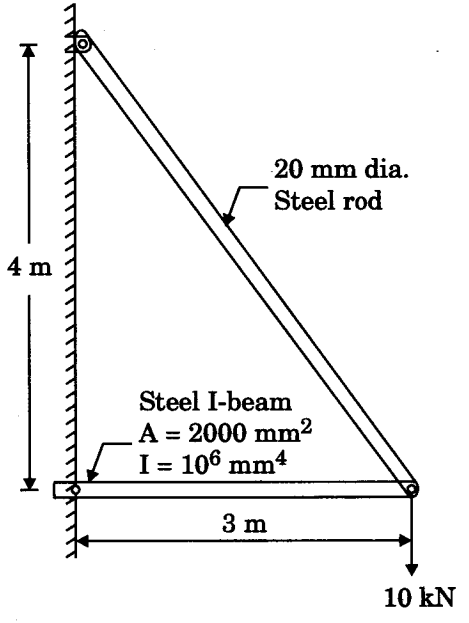


*Figure 2*

7. Answer any ***three*** of the following : *14*

(a) Derive cubic shape function for transverse deflection of a beam using Hermite's interpolation formula.

(b) Obtain finite element stiffness matrix for a beam with combined transverse and axial load.

(c) Elaborate on assembly elements and solutions techniques for static loads.

(d) Derive the shape function of a 3-noded CST element.