Indian Institute of Engineering Science and Technology, Shibpur

B.E. 8th Semester (Aerospace Engineering) End Semester Examinations, May 2014

Computational Solid Mechanics (AE 802)

Full Marks: 70 **Time: 3 hrs**

Answer any five (5) questions
All questions are of equal value

1. Brief on the following (any four):
    (a) Pascal Triangle
    (b) C^0 and C^1 element
    (c) Consistent nodal loads
    (d) Subparametric and Superparametric formulation
    (e) Jacobian

2. A prismatic cantilever bar of length l and cross-sectional area A and made up of material of constant modulus of elasticity E is subjected to a linearly varying load of intensity $q = cx$. Considering the displacement field $u = a_1x + a_2x^2 + a_3x^3$, deduce the solution in the form $u = \frac{c}{6AE}(3l^2x - x^3)$.

3. A prismatic cantilever bar of length l and cross-sectional area A and made up of material of constant modulus of elasticity E is subjected to a linearly varying load of intensity $q = cs$. Discretizing the bar into 3 elements, prove that the tip displacement of the bar is $\frac{9cL^3}{AE}$, where $L = \frac{l}{3}$. Use FE form of Rayleigh – Ritz method.

4. (a) Discuss over the convergence requirement of FE analysis
    (b) What is patch test? Brief on the utility of patch test

5. Starting from fundamentals, derive the expressions for the shape functions of a quadratic bar element, through isoparametric formulation. Also derive the expression for Jacobian for the same.

6. What are the differences between Serendipity elements and Lagrangian elements? Detail on the process of deriving shape functions of a quadratic plane element of serendipity family.

7. With any suitable example discuss the application of coordinate transformation in deriving stiffness matrix for (i) inclined support in a plane truss (ii) joining dissimilar element.

8. Differentiate between the thin plate deformation as per Kirchhoff theory and Mindlin theory. Starting from fundamentals, derive the expression of strain energy using Kirchhoff element.

9. Starting from fundamentals, derive the FE form of Galerkin method for a uniform bar subjected to axial loading of $q = q(x)$.