53 (CE 813) FEAN

2015

FINITE ELEMENT ANALYSIS

Paper : CE 813

Full Marks : 100

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

Answer **all** questions.

1. What is finite element method ? Write the various steps involved in finite element technique.   4+6=10

2. What is shape function ? Find the expression for shape function of a 4-noded rectangular element.   4+6=10

3. Explain plane strain and plane stress problem and write their constitutive relationship.   10

4. Derive the equilibrium conditions for 3-dimensional stress distribution. 10

5. Explain the concept of isoparametric and super parametric element in finite element method. 10

6. Explain the Pascal's triangle and write the displacement function for 8-noded quadrilateral element. 10

7. The state stress $\sigma_{ij}^{(1)}$ and $\sigma_{ij}^{(2)}$ at two different points in a body are shown below. Determine which state is more critical to yielding if the following criteria of yielding are used : 10

   (a) Octahedral normal stress, σ_{oct}.

   (b) Octahedral shear stress, τ_{oct}.

   $$\sigma_{ij}^{(1)} = \begin{bmatrix} 10 & 0 & 3 \\ 0 & 3 & 0 \\ 3 & 0 & 2 \end{bmatrix} \text{ (units of stress)}$$

   $$\sigma_{ij}^{(2)} = \begin{bmatrix} 3 & 0 & 0 \\ 0 & -7 & 0 \\ 0 & 0 & -5 \end{bmatrix} \text{ (units of stress)}$$

8. Explain the principle of Rayleigh-Ritz and principle of minimum potential energy method. 5+5=10

9. Find the expression for natural coordinates for a two noded element in terms of L1 and L2, when ranges is 0 to 1. 10

10. Integrate the following over the entire length 'l' of the element : 5+5=10

(a) $\int_0^l L_1^1 L_2^2 \, dx$

(b) $\int_0^l L_1^0 L_2^1 \, dx$