Code: 13A01606

R13

B.Tech III Year II Semester (R13) Supplementary Examinations December 2016

FINITE ELEMENT METHODS IN ENGINEERING

(Civil Engineering)

Time: 3 hours Max. Marks: 70

PART - A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Explain the common principle used in FEM and finite difference method.

(b) What is principle of virtual work?

(c) Draw the sketches of shape functions N_1 and N_2 for a 2-noded 1-D line element.

(d) Draw the sketches of 3-D elements, use for 3-D stress analysis in FEM.

(e) Based on which principle element stiffness matrix is derived. Explain.

(f) Explain the types of nodal load vectors.

(g) What is the concept of isoparametric elements?

(h) Write the advantages of Lagrangian elements over serendipity elements.

(i) Write the sampling points and weight functions for 2 x 2 Gauss quadrature.

(j) Explain assembly of elements.

PART - B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT - I

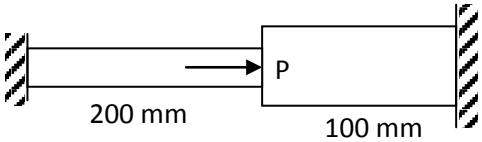
2 Derive the maximum deflection for a simply supported beam subjected to uniformly distributed load throughout the span and a central concentrated load.

OR

3 For a plane stress triangular element with nodes P (1, 2), Q (4, 1) and R (3, 6) all units in meters. Obtain the shape functions N_1, N_2 and N_3 at the point (2, 3).

UNIT - II

4 Determine the element stiffness matrices, global stiffness matrix, nodal displacements and stress in each bar for a stepped 1-D bar as shown in figure below.



Steel $A_1 = 1000\ mm^2$ $E_1 = 100\ GPa$

Bronze $A_2 = 2000\ mm^2$ $E_2 = 83\ GPa$

OR

5 Derive the shape function matrix for a LST element.

UNIT - III

6 Derive the element stiffness matrix and nodal load vectors for a CST element.

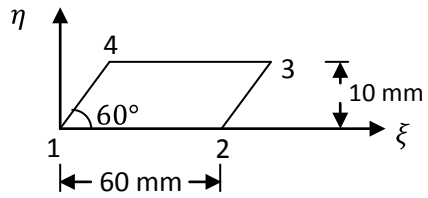
OR

7 Derive the strain displacement matrix for a linear model rectangular element i.e. 4-noded rectangular element.

Contd. in page 2

UNIT - IV

8 Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in figure below.



OR

9 Draw the Pascal's triangle for Lagrangian elements and serendipity elements. Explain.

UNIT - V

10 Evaluate numerically $\frac{1}{2}\int_{-1}^{+1} N^T N d\xi$ for the quadratic bar element. The shape functions are:

$$N_1 = \frac{1}{2}(\xi - 1)\xi, \quad N_2 = -(\xi^2 - 1), \quad N_3 = \frac{1}{2}(\xi + 1)\xi.$$

OR

11 Write short notes on:

(a) Solution techniques for static loads.

(b) Static condensation.

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