Total No. of Questions : 8]

SEAT No. :

P3892

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[5155]- 141
M.E. (Civil - Structural Engineering)
FINITE ELEMENT ANALYSIS
(2013 Pattern) (Semester - II)

Time :3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of non Programmable electronic calculator is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) a) The potential energy of a simply supported beam of length '1' loaded by a central concentrated force P is $\Pi = \int_0^1 \frac{1}{2} El \left(\frac{d^2v}{dx^2} \right)^2 dx - Pv$, where EI is the modulus of flexural rigidity, 'v' is transverse deflection of the beam. Assuming the deflection function as $v = A \sin(\pi x/1)$, find the maximum deflection using Ritz method. Assume EI to be constant. **[4]**

b) Derive elemental stiffness matrix for a beam element using variational approach. **[6]**

Q2) a) Differentiate between

i) CST and LST elements.

ii) Grid refinement and use of higher order element. **[4]**

b) Write in detail the convergence requirements for a displacement function. Explain each requirement with suitable example. **[6]**

Q3) A beam fixed at its ends carries a central point load P. There is an elastic spring support under the load having stiffness $76EI/L^3$. Analyse the beam using direct approach of FEM. **[10]**

P.T.O.

Q4) a) For constant strain triangular element, derive shape functions using area coordinates and derive the strain displacement matrix[B]. **[5]**

b) Derive all the shape functions of an eight noded brick element of unit length. Consider the origin (0,0,0) at node 1. **[5]**

Q5) Write the expressions for normal and shear strain for the axisymmetric element and give the elasticity matrix [D] matrix for the axisymmetric element Derive from the first principles (Assuming displacement function) the stiffness matrix for a typical triangular axisymmetric element. **[10]**

Q6) A quadrilateral element has coordinates: A (0, 0), B (10, 0), C (10, 15), D (0,10). Transform this element into a square element in natural coordinates. Find out the Jacobian and its determinant. **[10]**

Q7) Write in detail about Mindlin's plate element. **[10]**

Q8) Write about the finite element formulation using four noded degenerated quadrilateral shell element. **[10]**