Total No. of Questions :8]

SEAT No. :

P4017

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[5255] - 514

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) For the following boundary value problem solve using point collocation method $\frac{d^2u}{dx^2} - u = x \quad 0 \le x \le 1$. The conditions given are $u(0) = 0$ and $u(1) = 0$. Choose $x = 0.25$ and 0.5 as the collocation points. Consider the approximate solution in form of $a_1 (x - x^2) + a_2(x^2 - x^3)$. **[6]**

b) Derive elemental stiffness matrix for a plane truss element or 1 - D bar element using variational approach. **[4]**

Q2) a) From the fundamentals derive the shape functions of CST element in area coordinates and hence obtain strain - displacement matrix for the element. **[5]**

b) Explain the use of Pascal's triangle in formulation of displacement function in Finite element method. Explain with suitable examples, compatible and completeness requirements of displacement functions. **[5]**

Q3) Analyse the plane truss shown in the Fig. 1 using direct method of finite element method. Take AB=1000 mm, BC=1000 mm and height of truss =1000 mm. D point is at center of CB and subjected to horizontal load of 200 kN. Young's Modulus is 200 GPa **[10]**

P.T.O.

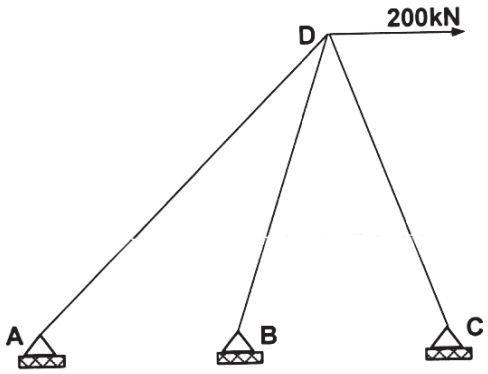

Fig. 1

Q4) a) What are serendipity elements? Derive the shape function for eight noded serendipity element in Cartesian or natural coordinate system. **[6]**

b) For a tetrahedral element derive the shape function in terms of the volume of tetrahedral and express the displacements in terms of shape function. **[4]**

Q5) a) Write the expressions for normal and shear strain for the axisymmetric element and give the isotropic stress/strain relationship for the axisymmetric element. **[3]**

b) Derive the stiffness matrix for a typical triangular axisymmetric element starting from fundamentals. **[7]**

Q6) Explain the term Jacobian matrix. Formulate strain displacement matrix for a two dimensional isoparametric element in plane elasticity problem, using Jacobian matrix. **[10]**

Q7) Write a short note on any one type of plate bending elements. Explain conformity of the displacement function of the element. **[10]**

Q8) a) Which elements are called as shell elements? Write short note on Flat shell element. **[5]**

b) Write a note on Ahmad's degenerated solid element. **[5]**

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