Total No. of Questions :8]

SEAT No. :

P3843

[Total No. of Pages : 3

[5462]-541
M.E. (Civil - Structural Engineering)
FINITE ELEMENT METHOD
(2017 Course) (Semester - II) (501007)

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

Instructions to the candidates:

1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and Q.7 or Q.8*
2) *Figures to the right indicate full marks.*
3) *If necessary, Assume suitable data and indicate clearly.*
4) *Use of electronic pocket calculator is allowed.*

Q1) a) Solve using Galerkin's method the differential equation governing a physical phenomenon as

$\frac{d^2y}{dx^2} + 1000x^2 = 0$ for $0 \le x \le 1$, Boundary conditions are $y(0)=0$; $y(1)=0$. Assume trial function : $y = a(x - x^4)$. **[5]**

b) Explain the use of Pascal's triangle in formulation of displacement function. Explain the convergence requirement of displacement function with suitable example. **[4]**

OR

Q2) a) Using variational principle, formulate the stiffness matrix for beam element. **[5]**

b) Using area coordinate, derive the shape functions for a CST element. Hence derive the strain displacement matrix for CST element. **[4]**

Q3) a) i) What are natural coordinates? What are the advantages of the same?

ii) Explain the use higher order element versus grid refinement in finite element analysis. **[5]**

b) Determine the elemental stresses, if the displacements of an quadrilateral element for plane stress condition is found primarily as $u = [0 \quad 0 \quad 0.003 \quad 0 \quad 0.004 \quad 0.006 \quad 0 \quad 0]^T$ in m and the strain displacement matrix is found to be

$$B = \frac{1}{2}\begin{bmatrix} -0.5 & 0 & 0.5 & 0 & 0.5 & 0 & -0.5 & 0 \\ 0 & -1 & 0 & -1 & 0 & 1 & 0 & 1 \\ -2 & -1 & -2 & 1 & 2 & 1 & 2 & -1 \end{bmatrix},$$ and E = 200 Gpa, μ = 0.25 **[4]**

OR

Q4) a) For the four noded element shown in figure 2, determine the Jacobian matrix. **[5]**

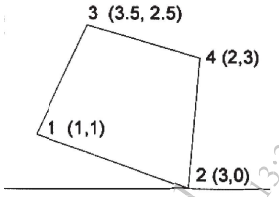

Figure 2

b) What is the peculiarity of serendipity element? For a eight noded serendipity element in quadrilateral form, derive shape function for any corner and any mid-side node of the element. **[4]**

Q5) a) Explain shear locking phenomenon. **[4]**

b) Explain the finite element formulation for shear deformation theory, Explain the Midlin's plate element and briefly explain the formulation of stiffness matrix. **[12]**

OR

Q6) a) Derive all matrices to formulate the stiffness matrix of ACM plate bending element. **[8]**

b) Explain the convergence requirements of displacement functions. Explain how ACM plate bending element is non-conforming element. **[8]**

Q7) a) For axisymmetric element, write constitutive relations and hence obtain the element stiffness matrix for a typical triangular element for its application in solving a problem of cylinder subjected to internal pressure. **[6]**

b) Explain with neat sketches the various three dimensional elements used in the anlaysis of shells. What are Flat shell element? Explain their shortcoming. **[10]**

OR

Q8) a) An axisymmetric stress analysis problem is to solved using four noded rectangular ring element. Write the displacement function for this and hence write briefly the steps for deriving the elemental stiffness matrix. **[8]**

b) Explain the concept of degenerated solid elements. Write the displacement field for 4 noded degenerated shell element. **[8]**