Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-II Examination July 2010

Subject code: 722001

Subject Name: Finite Element Method

Date: 05 /07 /2010 **Time: 11.00am – 1.30pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Discuss the three units of programme which is used in FEM application giving the meanings of Pre processor, processor and post processor units of programme. **06**

(b) What is CST element? Why it is known as CST element? Derive the stiffness matrix for the CST element having three nodes at (0,0), (3,0) and (0,4). The value of E = 91×10^9 N/m^2, poisson's ratio = 0.3 and thickness = 10mm. **06**

Q.2 **(a)** What is axisymmetric element? What are the various strains involved in it? Which structures can be solved by this type of element? **06**

(b) What is pascal's triangle? How is it used in FEM. Also give the shape function based on it for eight nodded plate buckling problem and four nodded plate bending element. **06**

OR

(b) What is tetrahedral element? What are the various shape functions for the element? What will be D matrix for the same? Discuss the steps involved in the calculating the stiffness matrix for the same. **06**

Q.3 **(a)** A three nodded axial member has three nodes at x=0. x=2 and x=4m. Derive the shape functions using lagrange interpolation functions and hence derive the stiffness matrix for the same. **06**

(b) In the above problem the member is fixed at x=0 and free at x=4m and is loaded by a skin friction tensile load of 30kN/m, and an axial pull of 100kN at x=4, derive the consistent load vector. Also calculate the deflection at the three nodes and strain equation in the member. **06**

OR

Q.3 **(a)** A three nodded axial member has three nodes at x=0. x=3 and x=6. Derive the shape functions for it using isoparametric element. Also derive the stiffness matrix using two point gauss point integration. **06**

(b) In the above problem the member is fixed at x=6 and free at x=0 and is loaded by a skin friction compressive load of 30kN/m, and an axial pull of 100kN at x=8, derive the consistent load vector. Also calculate the deflection at the three nodes and strain equation in the member. **06**

Q.4 **(a)** Discuss the various uses of Jacobean matrix. For a four nodded plate element having four nodes at (0,0), (5,1), (5,4) and (0,3) calculate the Jacobean matrix using one point integration. (All dimensions are in meters.) **06**

(b) For the above problem calculate the stiffness matrix using one point integration. Assuming the element is plane stress element and the value of E = 91×10^9 N/m^2, poisson's ratio = 0.3 and thickness = 15mm. **06**

OR

Q.4 **(a)** Discuss the steps involved in the derivation of stiffness matrix for the plate bending element giving its displacement function and strain functions. **06**

(b) What is plane strain condition? Discuss the different types of problems that can be solved by plane strain condition. Also derive the D matrix for the same. **06**

Q.5 **(a)** A cantilever beam of span 6m has flexural rigidity of 30000kN-m^2. It is loaded by a point load of 60kN at x=6 and an udl of 10kN/m. It is fixed at x=0 and free at x=6m. Assuming the deflection function as $y(x) = c_1*x^2+c_2*x^3$, calculate the maximum deflection at x= 6m and maximum bending moment at x = 0m by minimization of the potential energy. **06**

(b) A beam ABCDE is hinged at A and E and supported on roller at C. The various spans are as mentioned. AB=3m, BC=3m, CD=3m and DE=3m. The flexural rigidity of AB and DE is 2EI while BC and CD is EI. If the beam is loaded by an udl of 10kN/m, analyze the beam using symmetry and elements of 3m length. **06**

OR

Q.5 **(a)** A simple support beam of span 10m has flexural rigidity of 50000kN-m^2. It is loaded by a point load of 100kN at x=5 and an udl of 20kN/m. Assuming the deflection function as $y(x) = c_1*x^3+c_2*x^4$, calculate the maximum deflection at x= 5m and maximum bending moment at x = 5m by minimization of the potential energy. **06**

(b) A beam ABCDE is fixed at A and E. The various spans are as mentioned. AB=4m, BC=4m, CD=4m and DE=4m. The flexural rigidity of AB and DE is EI while BC and CD is 2EI. If the beam is loaded by an udl of 20kN/m, analyze the beam using symmetry and elements of 4m length. **06**

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