Registration No : | | | | | | | | | | |

Total Number of Pages : 02

M.Tech
P1CIBC04

1st Semester Regular/Back Examination 2019-20
FINITE ELEMENT ANALYSIS AND ITS APPLICATION TO THE CIVIL ENGINEERING
BRANCH : CIVIL ENGG., GEOTECHNICAL ENGG, SOIL MECHANICS, SOIL MECHANICS & FOUNDATION ENGG, STRUCTURAL & FOUNDATION ENGG, STRUCTURAL ENGG, TRANSPORTATION ENGG, WATER RESOURCE ENGG, WATER RESOURCE ENGG AND MANAGEMENT
Max Marks : 100
Time : 3 Hours
Q.CODE : HRB730
Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Write disadvantages of non-conforming elements.
b) State difference between forward and backward finite difference.
c) Provide two examples of Axisymmetric Elements.
d) State Compatibility condition for two dimensional systems.
e) Write stiffness matrix for two noddedbar element.
f) What do you mean by Convergence of Partial Differential Equations?
g) Write two assumptions made in thin plates with small deflections theory.
h) Differentiate between external node and internal node.
i) Define Geometric Isotropy.
j) Differentiate between essential and natural boundary condition.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A beam having length 20 m is fixed at one end and hinged at other end. The beam is loaded with a concentrated load of 150kN at middle. Find out the slope and deflection under the load using finite element method. EI is constant for the beam. Where E= Young's modulus of elasticity, I= moment of inertia
b) Determine the expression for stain displacement matrix for a two nodded bar element using Cartesian coordinates.
c) Evaluate $\int_3^8 \frac{dx}{x^3}$ using Gaussian three point formula.
d) Write note on Gauss Seidel Method.
e) Describe about various applications of finite element methods through illustrative Examples.
f) State and explain the convergence requirements of polynomial shape functions.
g) Write difference between plane stain and Plane stress with examples.
h) Write note on Rayleigh-Ritz method.
i) Derive the expression for stiffness matrix for two nodded frame element.
j) State the various differences between Isoparametric, Superparametric, and Subparametric elements along with their uses.
k) Derive the shape function for three nodded triangular (CST) element.
l) Write note on Pascal Triangle.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Explain in detail about various steps involved in Finite Element Analysis. State the advantages of finite element method over finite difference method. **(16)**

Q4 A two span continuous beam ABC with end A is fixed and C is hinged. The span AB is loaded with uniformly distributed load having intensity of 50 kN/m and the span BC carries a point load of 120 kN at middle. The length of span AB and BC are 10 m and 15 m respectively. Use finite element method for analysis assuming uniform flexural rigidity. (EI is constant)Where E= Young's modulus of elasticity, I= moment of inertia **(16)**

Q5 A two hinged portal frame ABCD consist of vertical columns AB and CD of 6 m height each and beam BC of 10 m length. The frame carries a vertical point load of 150 kN on the beam (BC) at a distance 4 m from B. Find the reactions at supports and draw the bending moment diagram for the frame. Assume all members have same flexural rigidity (EI is constant). Use finite element method. The ends A and D are hinged.Where E= Young's modulus of elasticity, I= moment of inertia. **(16)**

Q6 Analyze the plane truss shown in Fig using finite element method. GivenE = 210GPa andArea of all members (A) $=1\times10^{-4}$ m^2, determine: **(16)**

- The global stiffness matrix for the structure.
- The horizontal displacement at node 2.
- The horizontal and vertical displacements at node 3
- The reactions at nodes 1 and 2.
  Where E= Young's modulus of elasticity