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

Total Number of Pages: 02

M.TECH
P1CIBC04

1st Semester Regular Examination 2016-17
Finite Element Analysis and its Application to the Civil Engineering
BRANCH: Structural Eng., Geotechnical Eng., Water Resources Engineering
Time: 3 Hours
Max Marks: 100
Q.CODE: Y906
Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: ***Short answer type*** **(2 x 10)**

a) Write the general formula for Gauss-Seidel method.
b) What is global coordinates and local coordinates?
c) Write down the advantages and disadvantages of FEM.
d) Write forward finite difference formula for second derivative.
e) Define shape function.
f) State various convergence criteria in FEA.
g) What is the importance of Pascal's triangle in FE analysis?
h) What is Jacobean matrix?
i) Write the displacement function for a *n-degrees* of polynomial.
j) Write the generalized stiffness matrix of a space truss member.

Q2 **a)** What is finite difference method? Derive central difference formula for second derivate from Taylor's series. **(10)**

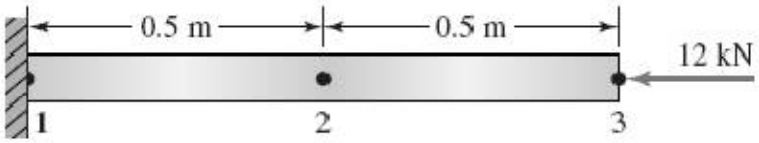
b) Apply the Jacobi method to solve **(10)**

$5x_1 - 2x_2 + 3x_3 = -1$
$-3x_1 + 9x_2 + x_3 = 2$
$2x_1 - x_2 - 7x_3 = 3$

Continue iterations until two successive approximations are identical when rounded to three significant digits.

Q3 **a)** What is Finite Element Method (FEM) Briefly describe different steps involved in FEM analysis. **(10)**

b) A steel rod subjected to compression is modeled by two bar elements, as shown in Figure1 below. Determine the nodal displacements and the axial stress in each element. **(10)**



$E = 207$ GPa $\quad A = 500$ mm^2

Figure 1

Q4 **a)** The plane truss shown in Figure 2 below is composed of members Having a square 15 mm × 15 mm cross section and modulus of elasticity E = 69 GPa. **(10)**

a) the element stiffness matrix for each element

b) the global stiffness matrix

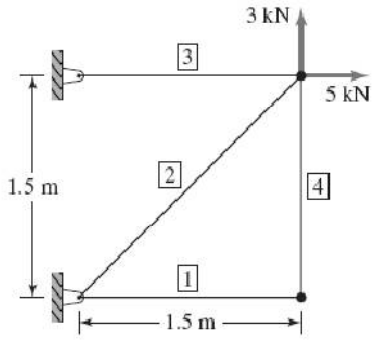


Figure 2

b) Derive the shape function, strain displacement relation matrix [B] and element stiffness matrix for a 3-noded triangular element. (CST) **(10)**

Q5 **a)** For the continuous beam and loading shown in figure 3. Determine **(10)**

a) the element stiffness matrix for each element

b) the global stiffness matrix

c) the slopes at supports. Take EI as 400 units.

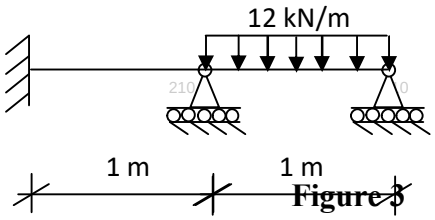


Figure 3

b) Give two example of plane strain problem and derive the strain components as function of stresses and E value. **(10)**

Q6 **a)** What is Isoparametric elememt. Give different types of 1D, 2D and 3D isoparametric element. Derive the element stiffness matrix for a four node isoparametric element. **(10)**

b) Write short notes on Lagrange Interpolation and Serendipity elements. **(10)**

Q7 **a)** What are the assumptions in thin plate theory? For a four nodded bilinear plate bending element derive the strain displacement matrix, stress strain relationship and element stiffness matrix. **(10)**

b) What is the utility of Numerical integration in Finite element analysis? How is the order of integration decided? Explain Gauss quadrature for two dimensional integrals. **(10)**