Ref. No. : Ex/CE/5/T/501/2018(S) (Old)

Name of the Examinations: B.E. Civil Engineering (Part Time) Fifth Year First Semester (Old) Supplementary Exam - 2018

Subject : THEORY OF STRUCTURES-IV Time : Three (3) Hours Full Marks : 100

Instructions : Answer any four questions

Question 1

a) In the terminology of mechanics of shell, define Gaussian curvature. (2)

b) In terms of Gaussian curvature, how is shell geometry classified? (3)

c) Develop the Lagrangian based interpolation functions or shape functions for a cubic one-dimensional finite element. (8)

d) The strain tensor at a point in a body is given by

$$\begin{bmatrix} 12 & 3 & 4 \\ 3 & 8 & -4 \\ 4 & -4 & 18 \end{bmatrix} x10^{-3}$$

Determine the normal and the shear strain on a plane whose direction cosines with respect to the coordinate direction are given by $l = m = n = 1/\sqrt{3}$. (12)

Question 2

a) Develop the moment - curvature relationship for a laterally loaded plate undergoing small deflection. (10)

b) Develop the expression for (i) Displacement (ii) Moment (iii) Edge shear (iv) Corner reaction for a simply supported plate subjected to a bi-harmonic load. (15)

Question 3

For a given differential equation $-\frac{d}{dx}\left[2\frac{du}{dx}\right] + 3u - x^2 = 0$ defined in the interval $0<x<3$ find the possible function which is a solution to the differential equation while satisfying the boundary conditions defined by $du/dx = 1$ at $x = 0$ and $u = 2$ at $x = 3$. Also define the weighting functions that are required to solve the problem using (i) collocation method (ii) Galerkin method. Find the solution for the problem at an interval of 0.5 units using both the methods. (25)

Question 4

a) Obtain the strain transformation relationship for shear strain in two-dimension. (10)

b) Determine the orientation of the planes on which maximum shearing stresses occur in a three-dimensional elastic body. (8)

c) The state of stress at a point is defined by the stress components: $\sigma_{11} = 6$, $\sigma_{22} = \sigma_{33} = 0$, $\sigma_{12} = 2$, $\sigma_{13} = 2$ and $\sigma_{23} = 4$ (MPa). Find the principal stress, one of the principal planes and the greatest shear stress. (7)

Question 5

a) Obtain the stress-strain constitutive relationship for plane strain problem. (6)

b) Stating clearly all the approximation based on Navier's contribution, obtain the expression for deflection for a simply supported plate (a x b) subjected to a square patch load P spread over an area of u x v placed with its centre at a distance of *m* and *n* from the X – and Y - axis. Assume any other relevant data. (19)