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

Name of the Examinations: B.E. Civil Engineering (Part Time) Fifth Year First Semester (Old) - 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 quadratic one-dimensional finite element. (10)

d) Develop the relationship to express Young's Modulus (E), Poisson's ratio (ν) and Shear modulus (G) in terms of Lame's Parameter. (10)

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

The axial deformation 'u' of vertical rod is expressed by the following differential equation

$$\frac{d}{dx}\left[EA\frac{du}{dx}\right] + x = 0 \quad 0 < x < 3$$

Based on weak variational principle, develop the governing finite element (FE) equations for the said problem while discretizing the domain using three (3) uniform linear finite elements. The load profile applied on the rod is shown in figure 1. (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. (7)

c) The principal stresses acting at a point are given by $\sigma_{11} = 15.4$, $\sigma_{22} = 12.65$ and $\sigma_{33} = 6.8$ (MPa). Determine the normal and shear stresses acting upon an oblique plane whose normal is defined by the vector $u_n = 0.732u_1 + 0.521u_2 + 0.439u_3$. (8)

Question 5

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

b) Stating clearly all the approximation based on Navier's contribution, obtain the expression for deflection and moments for a simply supported plate subjected to a uniformly distributed load q_1. Assume any other relevant data. (19)

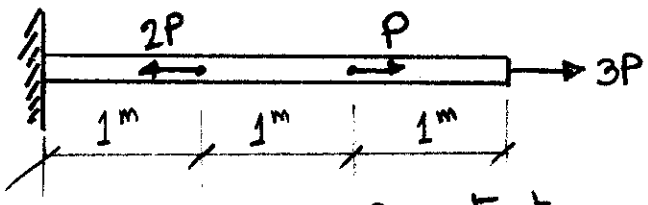

Figure - 1