B. Civil Engineering (Evening) 5th Year 1st Semester Supplementary Exam – 2017

Subject: Theory of Structures – IV **Time: Three (3) Hours** **Full Marks: 100**

Answer Any Four (4)

Q1 (a) State the Poisson's Condition in context to the Free Edge boundary condition for laterally loaded plate. How is the condition taken care of according to Kirchhoff assumption? (10)

(b) Develop the governing differential equation $\nabla^4 w = \frac{q}{D}$ for a laterally loaded plate with small deflection. (15)

Q2 Based on Navier's Method of solution obtain the central deflection for a rectangular plate subjected to a point load 'P' applied at the center of a plate of size a x b. Assume any other relevant data. (25)

Q3 The equilibrium of a physical system is described by the following differential equation

$$-\frac{d^2u}{dx^2} - 2u + x^2 = 0 \quad for\ 0 < x < 1$$

with u(0) = 0 and u(1) =1.

Obtain the solution to the differential equation using (i) Galerkin weighted residual method (ii) Collocation Method. Tabulate the results for five (5) intermediate points. (25)

Q4 (a) Define Stress Invariants. (5)

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

$$\begin{bmatrix} 12 & 3 & 4 \\ 3 & 8 & -4 \\ 4 & -4 & 18 \end{bmatrix} x\ 10^{-3}$$

Determine the normal strain along a direction whose direction cosines with respect to the coordinate direction are given by l = m = n = $1/\sqrt{3}$.
Determine the principal strains and the direction of the principal axes. (20)

Q5 (a) Obtain the interpolation function for a four node isoparametric Lagrangian finite element and state the properties of the interpolation (shape) function. (10 + 4)

(b) Obtain the stress equilibrium equation for a 3-D continuum (5)

(c) Develop the stress transformation relationship for a 3-D stress tensor. (6)