

Name of the Examinations: B.E. CIVIL ENGINEERING (PART TIME) FOURTH YEAR SECOND SEMESTER - 2018

Subject : THEORY OF STRUCTURES-IV

Time : Three (3) Hours

Full Marks : 100

Instructions : Answer any four (4) questions

Q1 (a) 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)

(b) Develop the strain transformation relationship for shear strain (8)

(c) Obtain the interpolation function for a three (3) node isoparametric Lagrangian finite element and state the properties of the interpolation (shape) function (7 + 3)

Q2 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)

Q3 (a) Define Stress Invariants. (5)

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

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

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)

(c) Develop the stress transformation relationship for a 3-D stress tensor. (8)

Q4 (a) In a 3 – dimensional state of stress obtain the orientation of the planes on which maximum shear stress occurs. (10)

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

Q5 Based on Navier's Method of solution obtain the central deflection for a rectangular plate subjected to a uniformly distributed load applied on a plate of size $a \times b$. Assume any other relevant data. (25)