Ref. No. : Ex/CE/T/415/2019 (Old)

Name of the Examinations: B.E. CIVIL ENGINEERING FOURTH YEAR FIRST SEMESTER (Old) - 2019

Subject : THEORY OF STRUCTURES IV

Time : Three Hours Full Marks: 100

Part I

Instructions : Use Separate Answer scripts for each part (Answer any Two)

1. a) Develop the relationship between the octahedral shear stress and the stress deviatoric and explain the significance of the same. (7)
   b) Develop the Biharmonic equation in terms of the Airy's Stress function for a plane stress problem. (5)
   c) Develop the shape function for a 3-node Lagrangian element. (5)
   d) Develop the strain transformation relationship for shear strain (8)

2. Based on the weighted residual method of (i) Galerkin (ii) Collocation principle, obtain the solution for the differential equation

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

   having a mixed boundary condition u(0) = 0 and $\frac{du}{dx} = 1 \; at \; x = 1$

   Tabulate the results for every 0.25 unit interval. (25)

3. Using Airy's stress function approach obtain the solution for displacement and stress for a cantilever beam subjected to edge load at its free end. Assume the length of the beam as 'L' and depth as '2c'. Comment on the nature of the solution based on the assumption of the boundary condition. (25)

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Theory structures –IV

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Part –II

Assume reasonable values of any data if required

Answer Q 1 and any one question from Q2 and Q3

Notations have their usual meaning

Q 1 a) Derive the relationship of Moments and Curvatures in a plate and show that $\delta^2 w/ \delta^2 x + \delta^2 w/ \delta^2 y = M/D$ where $M = (M_x + M_y)/(1+v)$.

(b) A rectangular steel plate 3m X 4m simply supported at the edges carrying a uniformly distributed load of 10 KN/m^2. Find the maximum deflection of the plate. Derivation is needed assuming plate equation $\nabla^4 w = q/D$. Take v =0.24. Thickness of the plate is 40 mm **12+13**

Q2 Determine the stress distribution of N_ϕ at the center span and Nx at the edge of a simply supported symmetrical cylindrical shell of radius 12 m , span 30 m and central angle 120^0 under dead load of thickness 100 mm and live load of 0.75 KN/m^2 (detail derivation is required). **25**

Or

Q3 A spherical dome over a circular room is to be constructed. Diameter of the room is 25 m and the central rise is 8 m . Thickness of the dome is 100 mm. Live load = 0.75 KN/m^2. The dome is subjected to a concentrated load of 50 KN at the crown, Find the meridional stress and hoop stress at an interval of 10^0 from vertical axis. Deduce the expression for the above stresses. **25**