Name of the Examination: B. E. Civil Engg. 4th Year 1st Sem. Supplementary Exam 2018
Subject: Theory of Structure – IV   Time: Three (3) hours   Full Marks: 100
Part I
Use Separate Answer Scripts for Each Part

Question 1– Develop the two-dimensional equilibrium equation of an elastic problem in Polar Coordinates. Hence obtain the compatibility equation in the absence of body forces. Also comment on the nature of solution when the stress distribution is symmetrical about an axis.

(10+10+5)

OR

Question 1 - Obtain the deflection profile of a cantilever beam of unit width and a length 'L', depth '2c'. Also find the stresses at one of the extreme fibers located at the fixed end of the beam. Develop the solution procedure based on stress function approach and explain the special significance of the solution.   (15 + 5 + 5)

Question 2 – The equilibrium of a physical system is described by the following differential equation

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

with u(0) = 0 and u(1) =2.
Obtain the solution to the differential equation using Ritz's weak variational formulation. Compare the results with the results obtained using Collocation Method. Tabulate the results at four (4) intermediate points.   (25)

OR

Question 2 (a) List the properties of the interpolation/shape functions belonging to the Lagrangian Family of interpolation functions.

(b) Obtain the solution using (i) Galerkin Weighted Residual method and (ii) Least square Method for the differential equation

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

having a mixed boundary condition u(0) = 0 and du/dx = 1 at x = 1. List the results at five (5) intermediate points.   5 + 20

Question 3 (a) Obtain the Lagrangian interpolation functions for a cubic finite element.   (5)
(b) Develop the constitutive equation for a plane strain problem.   (5)

OR

Question 3 Deduce the significance of the Octahedral Shear Stress in the failure criteria of an elastic material.   (10)

Theory structures –IV

Time 3 hours   Full Marks 100

Use separate answer script for each part

Part –II (40 Marks)

Answer Q1 and any one from Q2 & Q3
Assume reasonable values of any data if required
Notations have their usual meaning

Q 1   A rectangular steel plate 3 X 3 m simply supported at the edges carrying a central concentrated load of 50 KN. Find the maximum deflection of the plate. Also calculate the moments at the centre of the plate. Derivation is needed assuming plate equation $\nabla^4 w = p/D$. Where p= uniformly distributed load .Take $v = 0.25$. Thickness of the plate is 80 mm .   20

Q2   . A spherical dome over a circular room is to be constructed. Diameter of the circular room is 25m and the central rise is 10 m. Thickness of the dome is 100 mm. Live load = 0.75 KN/m². The dome is also subjected to a concentrated load of 400 KN at the crown, Find the meridional stress and hoop stress at an interval of 20° from vertical axis. Deduce the expression for the above stresses. Sketch also the typical reinforcement generally provided in reinforced concrete dome. The dome is supported on a circular beam over the brickwork.

    20

Q3   Determine the stress distribution of N_ϕ at the center span of a simply supported symmetrical cylindrical shell of radius 14m , span 24 m and central angle 180° under dead load and live load intensity of 2.5 KN/m² (total). Assume $\partial N_x/\partial x + \partial N_{\phi x}/R\,\partial\phi + X = 0$, $\partial N_{x\phi}/\partial x + \partial N_\phi/R\,\partial\phi + Y = 0$ and $N_\phi/R + Z = 0$ where X, Y, Z = surface loading / unit area. Why the edge beam is needed along the free edges of the shell ? Find the maximum tension in the edge beam.   20