Ref. No.: Ex/CE/5/T/407/2023(S)

Bachelor of Engineering (Civil Engineering), Fourth Year Second Semester
Supplementary Examination, 2023

THEORY OF STRUCTURES – IV

Answer ANY FOUR Questions. **Full Marks – 100** **Time: 3 Hrs.**

---

1. A small Plate Element of size (dx x dy x h) is subjected to a load intensity q normal to its surface. Establish the equilibrium equations for the determination of the internal force components.

2. Draw the free-body diagrams of the forces acting on a cylindrical shell element and establish the equilibrium equations for the determination of the internal forces using Membrane Theory.

3. **(A)** Discuss the effects of plate buckling on the stability and ultimate strength of the plates.
   (B) A rectangular Steel Plate of size 5.0 m. x 1.2 m. x 0.04 m, simply supported at all four edges, subjected to a compressive load along the direction of 5 m. Calculate the Critical Buckling Stress of the Plate. For Steel, Modulus of Elasticity = 210000 MPa and $\mu = 0.3$. Approximately take β as 4.0.

4. A Spherical Dome having radius R is subjected to a vertical load w per unit surface area of the shell. Establish the expressions of the Meridional Stress (N_ϕ) and Hoop Stress (N_θ) from the equilibrium equations.

5. **(A)** Prove that for two perpendicular sides of a cubic element, the components of shearing stresses perpendicular to the line of intersection of these sides, are equal.
   (B) Establish the relation $G = E/2(1+\nu)$. The symbols have their usual meaning.

6. **(A)** Define Von-Mises Stress. Describe what it measures and its limitations.
   (B) A Stressed Element as loaded shown in the figure below. Determine the Von-Mises Stress. The material has a Yield Strength of 800 MPa. Calculate the Factor of Safety for the Von-Mises Failure criteria.