Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2013

Subject code: 731504 Date: 15-05-2013

Subject Name: Plates and Shells

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain difference between thin plate and thick plate. Derive the equation of cylindrical bending in thin plate with small deflection theory. **07**

(b) Use Fourier series to derive the expression for deflection of a simply supported plate subjected to UDL of size a x b. Find out the values of moment and deflection at centre. **07**

Q.2 **(a)** Find the maximum deflection in a circular plate subjected to a concentrated load óPô at the centre. The plate is fixed all around the edges. Take radius = 2.3m, t = 75 mm, з = 0.3, E = 210 GPa. P = 40 kN. **07**

(b) Calculate M_n, M_{nt} and M_t for plate (a x b) subjected to M_x = 450kN-m/mt width, M_y = 275 kN-m/mt width and M_{xy} = 175kN-m. Calculate also M_n(max) with their inclination w.r.t to one of the axis. Support your answer with necessary plots. **07**

OR

(b) Using finite difference method, determine the maximum deflection of a square plate (a x a) fixed all along its edges and subjected to a uniformly distributed loading óqô. Take mesh size,h = a/2. Compare the result if plate edges are all simply supported. **07**

Q.3 **(a)** Show that $M_n + M_t = M_x + M_y$ and $1/r_n + 1/r_t = 1/r_x + 1/r_y$ **04**

(b) Derive and draw deflected shape for plate under pure bending for given cases: **10**

(i) M_x = +2M, M_y = -2M, size of plate = a x 2a

(ii) M_x = +M, M_y = -2M, size of plate = a x a

OR

Q.3 **(a)** Evaluate maximum deflection at centre of thin plate with UDL of intensity q_o acting whole over using levyôs approach. **07**

(b) Design a tilted inverted umbrella type Hyperbolic shell supported by a central column of dia.400mm from following data. Length is 20m, width is 14m.tilting is along the longer side with height of one end is 1m and other is 3m from centre. Use M20 and Fe 415. **07**

Q.4 **(a)** Find N_{ϕ} and N_{θ} for spherical dome due to self weight and live load uniformly distributed. **07**

(b) Using membrane theory derives the condition of equilibrium for doubly curved surfaces. **07**

OR

Q.4 **(a)** Explain the superiority of curved elements compared to linear. **04**

Q.4 **(b)** A planetarium dome may be approximated as an edge-supported truncated cone. It is subjected to a snow load with a maximum accumulation over the **10**

dome q = 3.5 kPa. Assume that the dome is constructed of 15 cm thick concrete having the radii of the parallel circles equal to 50 m at the base and 25 m at the top, respectively. Determine the membrane stresses in the dome.

Q.5 **(a)** Give the classification of shell based on shell curvature with neat sketches. **07**

(b) A simply supported at (x = 0 and x = L) semicircular cylindrical shell is subjected to a snow load óqô which is uniformly distributed over its plan area. Given the radius of the shell is óaô, thickness is óhô, modulus of elasticity and Poissonôs ratio are E and ɜ respectively, determine the membrane stresses in the shell. **07**

OR

Q.5 **(a)** Develop basic equation of membrane analysis of a paraboloid of revolution. Give stress function ū , Z & R if 2a = 16m, 2b = 22m, rise = 2.5m and thickness = 80 mm. **07**

(b) A circular cylindrical barrel shell of semicircular cross section is simply supported at x = 0 and x = L (Fig. 1). The shell is subjected to its self-weight p. The edge beams are employed along the rectilinear edges of the barrel shell to resist the membrane shear forces S. (a) Determine the membrane forces N1, N2 and S. (b) Select the required cross-sectional area of the edge beam if the shell and the above beam are made of an aluminum with $\mathring{u}_y$ = 450MPa; ε = 0.3, and factor of safety is 2.0. Take a = 12m; L = 35m; and h =a/100. **07**

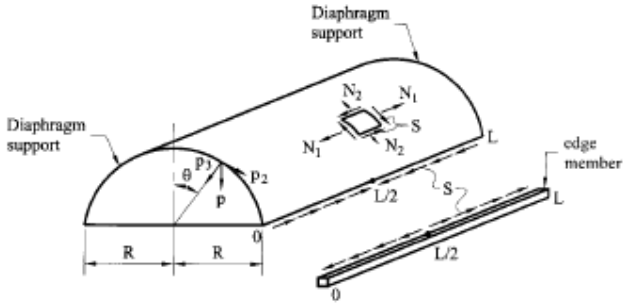

Fig.1