

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2014****Subject code: 731504****Date: 05-06-2014****Subject Name: Plates and Shells****Time: 02:30 pm - 05:00 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) Derive the equation of cylindrical bending in thin plate with small deflection theory. Define Neutral plane, anticlastic, synaclastic, inplane resistance, Stiffness factor. **07**
- (b) Using Naviers theory for simply supported rectangular plates, find the value of defection δ_w for plate of size $a \times b$ with line loading of intensity $\tilde{q}_0$. Also enlist the various merits of Naviers theory. **07**

- Q.2** (a) A circular thin plate having an effective diameter 450mm is clamped around its periphery and is subjected to uniform pressure of 190kN/m^2 . Find minimum thickness for plate if deflection at the centre not to exceed 0.55mm. Take $E=210\text{Gpa}$ and $\mu=0.25$. **07**
- (b) Calculate M_n , M_{nt} and M_t for plate ($a \times b$) subjected to $M_x = 340\text{kN-m/mt}$ width, $M_y = 225 \text{ kN-m/mt}$ width and $M_{xy} = 145\text{kN-m}$. Calculate also $M_n(\text{max})$ with their inclination w.r.t to one of the axis. Support your answer with necessary plots. **07**

OR

- (b) A simply supported plate of dimension $3 \times 4\text{m}$ carries a point load 30kN at the center. Find deflection, moment and shear at quarter span i.e. at coordinates (0.75, 1.0m). The thickness of plate is 120mm and is cast in M25 concrete. **07**
- Q.3** (a) Explain different boundary conditions exist in plate theory with neat sketches and necessary equations. **06**
- (b) Derive and draw deflected shape for plate under pure bending for given cases: **08**
- (i) $M_x = +2M$, $M_y = -2M$, size of plate = $2a \times a$
- (ii) $M_x = +2M$, $M_y = -M$, size of plate = $a \times a$

OR

- Q.3** (a) Evaluate maximum deflection at centre of thin plate with UDL of intensity $\tilde{q}_0$ acting whole over using levy's 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_θ and N_ϕ 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 dome $q = 2.7 \text{ kPa}$. Assume that the dome is constructed of 12 cm thick concrete having the radii of the parallel circles equal to 40 m at the base and 25 m at the top, respectively. Determine the membrane stresses in the dome. **10**
- Q.5 (a)** Give the classification of shell based on shell curvature with neat sketches. **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 N_1 , N_2 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 $\sigma_y = 460 \text{ MPa}$; $\nu = 0.3$, and factor of safety is 2.0. Take $a = 12 \text{ m}$; $L = 38 \text{ m}$; and $h = a/100$. **07**

OR

- Q.5 (a)** Develop basic equation of membrane analysis of a paraboloid of revolution. **07**
Give stress function $\bar{u}$, Z & R if $2a = 14 \text{ m}$, $2b = 20 \text{ m}$, rise = 2.5 m and thickness = 75 mm.
- (b)** A simply supported at ($x = 0$ and $x = L$) semicircular cylindrical shell is subjected to a snow load $\bar{q}$ which is uniformly distributed over its plan area. Given the radius of the shell is $\bar{a}$, thickness is $\bar{h}$, modulus of elasticity and Poisson's ratio are E and ν respectively, determine the membrane stresses in the shell. **07**

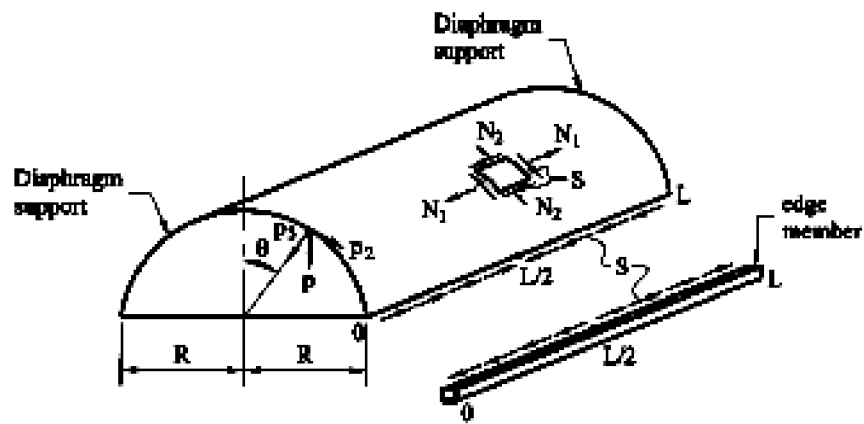


Fig.1
