# GUJARAT TECHNOLOGICAL UNIVERSITY ME Semester –III Examination Dec. - 2011

## Subject code: 731504 Subject Name: Plates and Shells Time: 10.30 am – 01.00 pm

Date: 08/12/2011

**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 07 of cylindrical bending in thin plate with small deflection theory.
  - (b) Derive the expression for deflection of a simply supported plate subjected 07 to UDL of size a x b. Find out the values of moment and deflection at centre. Use Navier's method.
- Q.2 (a) A circular thin plate having an effective diameter 300mm is clamped 07 around its periphery and is subjected to uniform pressure of 150kN/m<sup>2</sup>.Find minimum thickness for plate if deflection at the centre not to exceed 0.5mm.Take E=200Gpa and  $\mu$ =0.25.
  - (b) Calculate  $M_n$ ,  $M_{nt}$  and  $M_t$  for plate (a x b) subjected to  $M_x = 250$ kN-m/mt 07 width,  $M_y = 150$  kN-m/mt width and  $M_{xy} = 100$ kN-m. Calculate also  $M_n(max)$  with their inclination w.r.t to one of the axis.

#### OR

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

## Q.3 (a) Give merits and demerits of Navier's solution and Levy's solution 04

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

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

#### OR

- Q.3 (a) A square plate is subjected to uniformly distributed twisting moments  $M_{xy}$  04 =  $M_{yx}$  applied to all its four edges. Determine the expression for the deflection surface.
  - (b) Design a tilted inverted umbrella type Hyperbolic shell supported by a 10 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.
- Q.4 (a) Find  $N_{\theta}$  and  $N_{\Phi}$  for conical dome due to self weight and live load uniformly 07 distributed.
  - (b) Using membrane theory derives the condition of equilibrium for cylindrical 07 shell.

- Q.4 (a) Explain the superiority of curved elements compared to linear.
- Q.4 (b) A planetarium dome may be approximated as an edge-supported truncated 10 cone. It is subjected to a snow load with a maximum accumulation over the dome q = 2.5 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.
- 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 07 subjected to a snow load 'q' which is uniformly distributed over its plan area. Given the radius of the shell is 'a', thickness is 'h', modulus of elasticity and Poisson's ratio are E and v respectively, determine the membrane stresses in the shell.

#### OR

Q.5 A circular cylindrical barrel shell of semicircular cross section is simply 14 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  $\sigma y = 414$ MPa;  $\mu = 0.3$ , and factor of safety is 2.0. Take radius, R = 10m; L = 30m; and thickness, h = R/100.



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