APPLIED MECHANICS DEPARTMENT

SEMESTER-II: 2007-2008

AML 831: THEORY OF PLATES AND SHELLS

MAJOR TEST

Max. Marks - 100

Time - 2hrs

Note: Answer all questions

PART-A (CLOSED NOTES, MAX TIME - 30 Mins)

1. (i) State the criteria that the Ritz approximation functions ϕ_j must satisfy for a convergent solution. (4)

(ii) What are the necessary conditions to be fulfilled so that the membrane solution can be used as a particular solution of the general shell theory? Under which additional conditions, the membrane solution can be considered as the general solution of a shell? (3, 3)

(iii) a) Which stress resultants are considered in the membrane theory of shells?

b) How many governing equilibrium equations exist in the membrane theory?

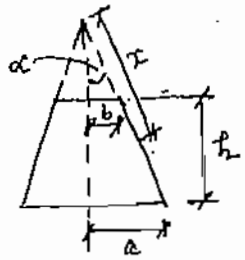
c) Are the Stresses obtained from membrane solution dependent on the material properties of the shell? (1, 1, 1)

2. (i) State the basic assumptions of Donnel-Mushtari-Vlasov (D-M-V) shell theory (only statements are sufficient, no equations required). (3)

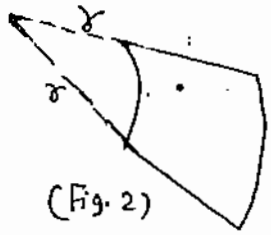
(ii) Find A_1, A_2, R_1 and R_2 of the conical shell shown in Fig. 1. (4)

(iii) a) Show in neat sketch(es) the stress resultants (in plane & bending) acting on a circular plate element (Fig. 2) under non-axisymmetric loading.

b) Which components of stress resultants vanish in case of axi-symmetric loading? (4, 1)



(Fig. 1)



(Fig. 2)

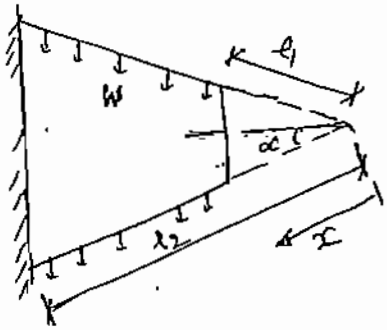
PART-B (OPEN NOTES)

1. A frustrum of a conical shell is mounted as shown in Fig. Q1 and is subjected to its own weight (W per unit area). For this loading, the surface force components are obtained as

$$q_3 = -W \cos\alpha \cos\theta, \quad q_x = W \sin\alpha \cos\theta$$

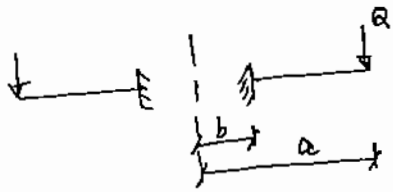
$$q_\theta = W \sin\theta.$$

Find N_x, N_θ, $N_{x\theta}$ as per the membrane theory of shells. Is this solution valid near the support of the shell? (10)



(Fig. Q1)

2. An annular plate (Fig. Q2) is subjected to a ring load Q per unit length at its outer edge. The inner edge of the plate is clamped. Find the deflection at the outer edge of the plate. Also, find the maximum moment M_r in (14)



3. The length of a cylinder is large enough so that the edge effect due to one end does not affect the response of the other end. Find the deflection and the rotation w, x of the long cylinder due to the applied edge moment (M) and shear (Q) loading. (10)

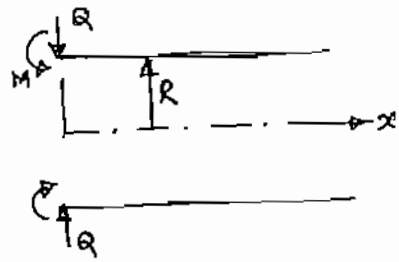


Fig. Q3

4. A cylindrical pipe of thickness h_1 is joined with another pipe of thickness h_2 (Fig. Q4). The cylinders are long enough so that the end conditions away from the junction do not affect the response near the junction. The joined pipe is subjected to an internal pressure p and an end wall force $N_1 = pR/2$.

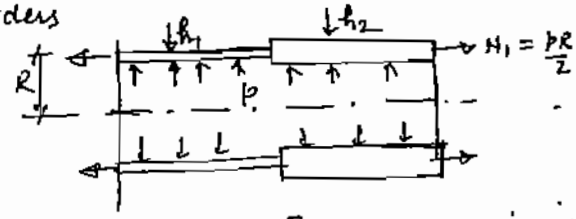


Fig. Q4

(i) Find the membrane solution (particular solution) wp for deflection of the two parts due to the loading. (3)

(ii) Using the solution obtained in Question 3, find the moment (M) and shear (Q) induced at the junction. (10)

5. A rectangular plate is clamped at $x=0$ and free at the other three ends. Assuming one-term Ritz approximation for the deflection

$$w_0 = c_{11} (x/a)^2$$

and using Ritz method, obtain the expression for deflection. Refer Fig. Q5. (15)

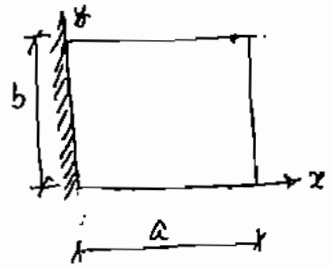


Fig. Q5

6. A square plate with two sides ($x=0, a$) simply-supported and the other two sides free is subjected to hydrostatic loading as shown in Fig. Q6. Obtain the deflection of the plate using Levy's method. (13)

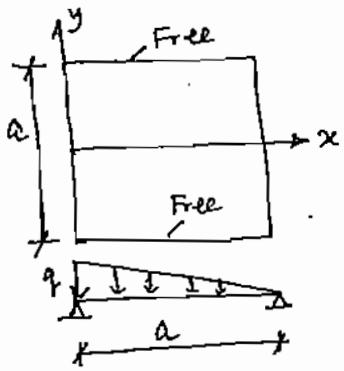


Fig. Q6