ELIZADE UNIVERSITY

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

B.Eng (Civil and Environmental Engrg.) Degree 1st Semester Examination 2020/2021 Session

CVE 507: Structural Analysis II **Units: 2** **Time Allowed: 3Hrs**

INSTRUCTION: Answer Question 6 and any other three

HOD'S SIGNATURE

Question 1

Calculate the membrane forces of a warehouse shell roof span 4m of a radius 12m and subtending a total angle of 60°. The shell is 60mm thick and carries a snow load of 500kN/m^2 of horizontal projection in addition to its own weight, taken as 1,500kN/m^2. Using the following formula with or without modification.

i. $P_2 = -\omega_o R \sin\Phi$

ii. $S = -2\omega_o x \sin\Phi$

iii. $P_1 = \frac{\omega_o}{R}\left(x^2 - \frac{1}{4}l^2\right) cos\emptyset$

(20 marks)

Question 2

a. State the limitation of membrane and beam theories for analyzing stresses in a shell. **(4 marks)**

b. The following observations were made in a Southwell test, carried out by a structural engineering student, of a pin-jointed steel tubular strut of length 1.76m.

Load (kN)	0.2	2.22	4.45	6.67	8.90	9.78	10.69	11.12	11.54	11.94
Cantral Def.	-	0.25	2.75	4.75	6.75	8.25	10:25	14.00	14.75	22.50
Load (kN)	12.37									
Central def.	75.00									

Central def. = Central deflection from initial position

Estimate from these observations the critical load of the strut and deduce its flexural rigidity EI. Why is it not necessary to specify the units in which the deflections were determined? **(16 marks)**

Question 3:

a. Derive or convert the following partial differential equations to their counterparts' finite difference equations.

i. $\frac{\partial^2 z}{\partial x \partial y}$

ii. $\nabla^2 Z = \frac{\partial^2 z}{\partial x} + \frac{\partial^2 z}{\partial y}$

iii. $\frac{\partial^4 z}{\partial x^2 \partial y^2}$

iv. $\frac{\partial^4 z}{\partial x^4} + 2\frac{\partial^4 z}{\partial x^2 \partial y^2} + \frac{\partial^4 z}{\partial y^4}$

(16 marks)

b. List four applications of shell roof.

Question 4:

a. Given that $\emptyset = a_1x^3 + a_2x^2y + a_3xy^2 + a_4y^3 + 10$ Demonstrate that the function specifies the stress fields of the plate show in Figure 1 and determine the values of the three stresses. **(15 marks)**

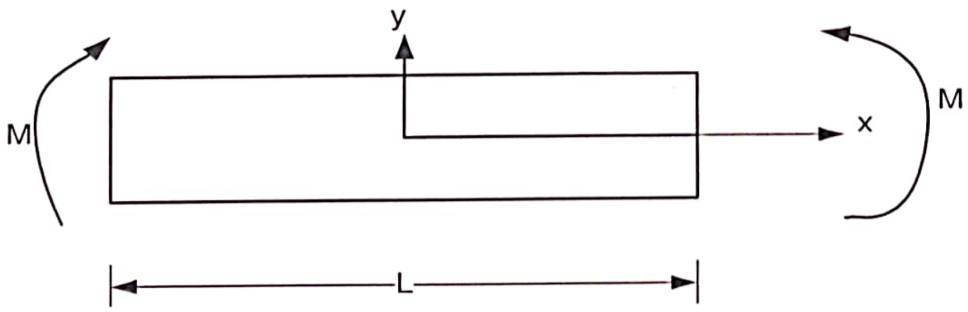
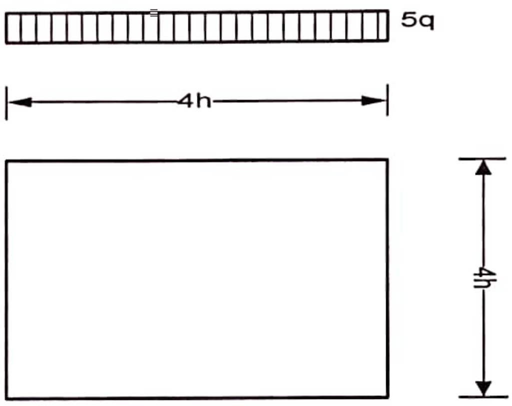


Figure 1

b. State the three procedural steps involved in the determination of stresses distribution on a body. **(4 marks)**

Question 5

a. The square plate of constant thickness shown in Figure 2 is built in along the edges. The plate is loaded with a uniformly distributed load of 5q intensity per unit area. Find the deflection at the mesh points of the plate using a square mesh of side h and use the expression $\nabla^4\omega = \frac{q}{D}$. Where ω is the displacement, D is the flexural rigidity of the plate which must be expressed in term of its young modulus, q = 10kN/m^2 and Poission ratio. The finite central difference operator shown by the side of Figure B may be used without derivation. **(15 marks)**



		1		
	2	-8	2	
1	-8	20	-8	1 × w = qh^4/D
	2	-8	2	
		1		

Figure 2

b. What are the causes of eccentricity in a straight member under compressive forces? **(5 marks)**

Question 6

Starting from the theory of elasticity, derive Laplace and Biharmonic equations. **(40 marks)**