EU
ELIZADE UNIVERSITY
FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
FIRST SEMESTER EXAMINATION (MARCH 2018)
2017/2018 ACADEMIC SESSION

HOD'S SIGNATURE

Instructions:

1) Attempt Four Questions
2) **Time Allowed:** 3 hrs
3) **SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAMINATION**

Course Title: **Structural Analysis II**

Course Code: **CVE 507**

ELIZADE UNIVERSITY

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

B.Eng (Civil and Environmental Engrg.) Degree

1st Semester Examination 2017/2018 Session

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

INSTRUCTION: Answer Question 1 and any other three

Question 1 (40 marks)

a. State two fold aims of this structural analysis course. (8 marks)

b. Starting from the theory of elasticity, derive Laplace and Biharmonic equations. (32 marks)

Question 2 (20 marks)

Given that $\emptyset = a_1x^3 + a_2x^2y + a_3xy^2 + a_4y^3$ Demonstrate that the function specifies the stress fields of the plate show in Figure Q2 and determine the values of the stresses. **(20 marks)**

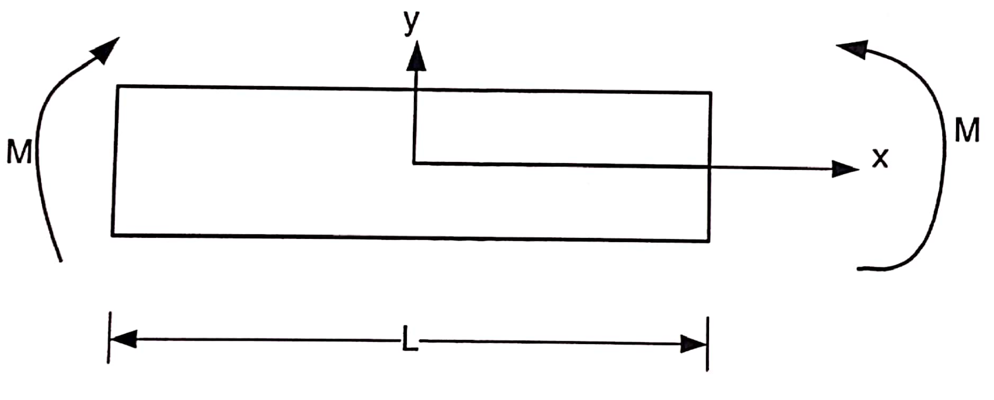

Figure Q2: stress fields of the plate

Question 3 (20 marks)

Convert the following partial differential equations to their counterparts' finite difference equations.

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

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

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

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

(20 marks)

Question 4 (20 marks)

The square plate of constant thickness shown in Figure Q4 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 and Poission ratio. The finite central difference operator shown by the side of Figure B may be used without derivation. **(20 marks)**

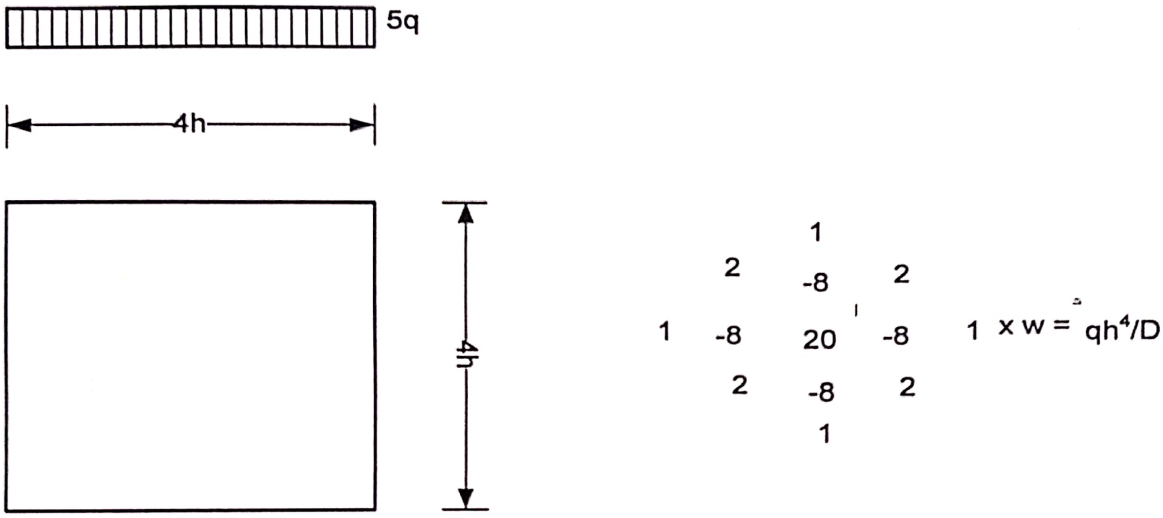

Figure Q4: square plate of constant thickness

Question 5 (20 marks)

Calculate the membrane forces in a shell of 4m span built of a radius 12m and subtending a total angle of 60°. The shell is 60mm thick and carries a load of 500kN/m^2 of horizontal projection in adition to its own weight, which can be 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 6 (20 marks)

a) What are the causes of eccentricity in a straight member under compressive forces? (6 marks)

b) The following observations were made in a Southwell test of a pin-jointed steel tubular strut of length 1.76m.

Load (kN)	0.22.22	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? **(14 marks)**