FACULTY OF ENGINEERING
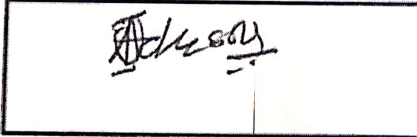
DEPARTMENT OF CIVIL ENGINEERING
SECOND SEMESTER EXAMINATION
(JULY 2018)
2017/2018 ACADEMIC SESSION

Course Title: Geotechnical Engineering

Course Code: CVE 510

HOD'S SIGNATURE

Instructions:

1) Answer 5 Questions including Question 3, 4 and 5

2) **Time Allowed: 3 hours**

3) **SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAMINATION**

ELIZADE UNIVERSITY ILARA-MOKIN
B.Eng. (Civil Engineering) Degree Examination
Second Semester 2017/2018 Session
CVE 510: Geotechnical Engineering

Final Examination

August 2018   Time Allowed: 3 hrs.

Instruction: Answer 5 Questions including Question 3, 4 and 5

Question 1 (20 Marks)

(a)   Describe briefly the process for solving problems in geotechnical engineering.   (5 marks)

(b)   Give and explain clearly 5 reasons why soil problems are unique   (5 marks)

(c)   List and explain the performance requirements in the design of foundations of engineering structures
                                                                                                                                      (5 marks)

(d)   What are the performance requirements in the design of foundations?   (5 marks)

Question 2 (20 Marks)

(a)   Explain what is meant by Plane stress loading in geotechnical engineering   (5 marks)

(b)   The state of stress in a body at a point can be defined by 3 independent stresses. Name them and show them with a sketch.
                                                                                                                                      (5 marks)

(c)   The stresses on two perpendicular planes at a point in a soil medium are as shown in Figure Q2. Find the major and minor principal planes, the maximum shear stress and the orientation of the maximum shear stress planes.
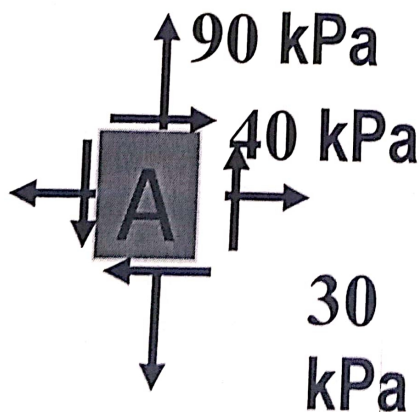   (10 marks)

Figure Q2: stresses on two perpendicular planes at a point in a soil medium

Question 3 (20 Marks)

(a) State the Mohr-Coulomb Failure theory. With a sketch explain its application to a c-φ soil. (4 marks).

(b) Name /list 3 tests for the determination of shear strength in the laboratory. Briefly explain one of them. (6 marks)

(c) The data in the Table below are from triaxial tests on a silty clay soil.

Tests	Confining Pressure kN/m^2	Deviator Stress kN/m^2
1	30	57
2	60	79
3	90	92

Find:

i.   The values for the cohesion and angle of internal friction;

ii.   the shear and normal stresses on the failure plane for test 3 and

iii. the orientation of the failure plane for test 3 (10 marks)

Question 4 (20 Marks)

(a)   Explain the following: Primary Consolidation; Compression Index, Coefficient of Consolidation, Preconsolidation Pressure (8 marks)

(b)   A load is applied as shown in Figure Q4 (a). The pressure – void ratio relationship for the clay layer is shown in Figure Q4 (b). Assume that the rectangular footing load imposes a pressure of 16.5 kN/m^2 at the midplane of the clay thickness. For sand and gravel deposit $\gamma = 19.60$ kN/m^3 and $\gamma_b = 9.80$ kN/m^3; For the clay soil, $\gamma_b = 9.60$ kN/m^3.

(i)   Determine the compression index of the soil. (4 marks)

(ii)   Estimate the average settlement from primary consolidation of the clay layer under the center of the footing if the clay is normally consolidated. (8 marks)
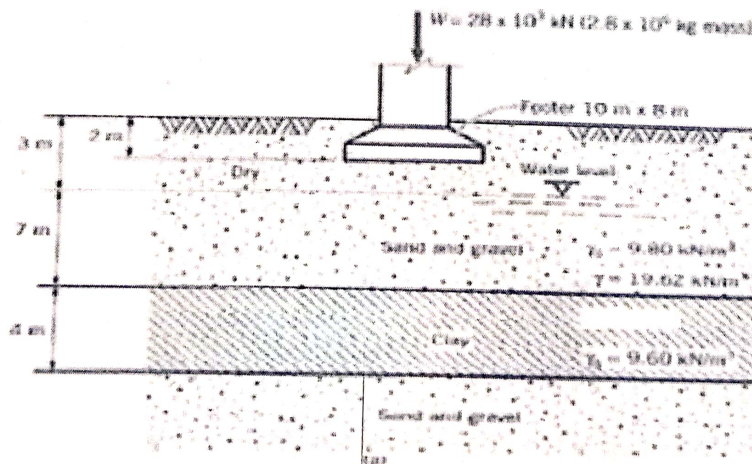

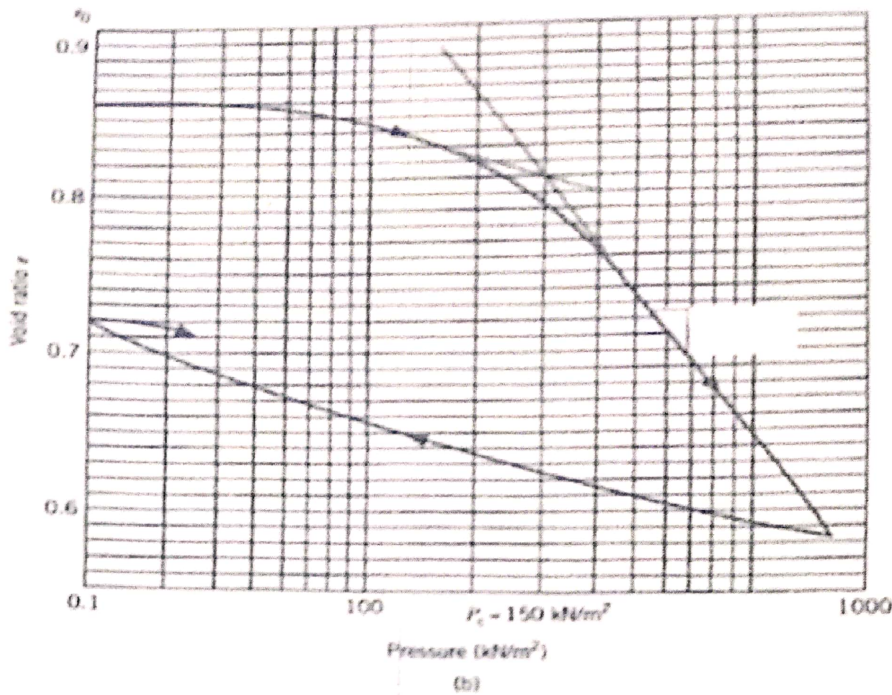Figure Q4: Soil layers and loading arrangement

Figure Q4: (b) Pressure-void ratio curve of clay layer

Question 6 (20 Marks)

(a) For a normally consolidated clay, the results of a drained triaxial test are as follows:

Chamber confining pressure $= 15$ kN/m^2

Deviator stress at failure $= 34$ kN/m^2

Determine the soil friction angle

(10 marks)

(b) For the normally consolidated clay, it is given that $\theta = 24°$. In a drained triaxial test, the specimen failed at a deviator stress of 175 kN/m^2. What was the chamber confining pressure, σ'_3?

(10 marks)

Question 7 (20 Marks)

(a) Using the Time–deformation plot during consolidation for a given load increment plot, clearly describe the three distinct stages of consolidation.

(4)

(b) Explain what is meant by the terms preconsolidation pressure and overconsolidation ratio.

(4)

(c) Name and explain a method for the determination of the preconsolidation pressure for a soil.

(6)

(d) The coordinates of two points on a virgin compression curve are given here:

$\sigma_1 = 190$ kN/m^2 $e_1 = 1.75$

$\sigma_2 = 385$ kN/m^2 $e_2 = 1.49$

Determine the void ratio that will correspond to an effective pressure of 500 kN/m^2. (6)