(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

(Main Campus)

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF

BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 222

COURSE TITLE: SOIL MECHANICS I

DATE: THURSDAY 28TH APRIL 2022 TIME: 8.00 – 10.00 AM

Instructions to Candidates

1. This paper contains FOUR (4) questions
2. Answer ALL questions in Section A and **ANY** TWO (2) in Section B
3. Formulae is provided at the end of the question paper
4. Examination duration is **2 hours**

SECTION A: Answer ALL questions **[30 *Marks*]**

Question One

a. Discuss the Atterberg limits of soil. **(6 Marks)**

b. Illustrate the phase diagram and establish the inter-relationship between the different parameters. **(10 Marks)**

c. In its natural condition a soil sample has a mass of 2290g and a volume of 1.15×10^{-3} m^3. After being completely dried in an oven the mass of the sample is 2035g. The specific gravity of the soil is 2.68. Determine the;

i. Bulk density **(2 Marks)**
ii. Unit weight **(3 Marks)**
iii. Water content **(3 Marks)**
iv. Void ratio **(3 Marks)**
v. Porosity **(3 Marks)**
vi. Degree of saturation **(3 Marks)**
vii. Air content **(3 Marks)**

d. Define soil compaction and state its importance in engineering practice. **(4 Marks)**

SECTION B (Answer TWO questions)

Question two (20 Marks)

The results of a sieve analysis were as tabulated below.

Sieve size (mm)	Mass Retained(g)
10	0.0
6.3	5.5
2	25.7
1	23.1
0.6	22.0
0.3	17.3
0.15	12.7
0.063	6.9

2.3g passed through the 63μm sieve. You are required to;

i. Calculate the percentage retained on each sieve **(7 Marks)**
ii. Determine percentage passing through each sieve **(5 Marks)**
iii. Plot the particle size distribution curve and comment on the soil type **(5 Marks)**
iv. Discuss the significance of sieve analysis **(3 Marks)**

Question Three (20 Marks)

i. An undisturbed soil sample was tested in a falling head permeameter. The results were:

- Initial head of water in stand pipe = 1500mm
- Final head of water in stand pipe = 605mm

- Duration of test = 281s
- Sample length = 150mm
- Sample diameter = 100mm
- Stand-pipe diameter = 5mm

Determine the permeability of the soil in m/s **(6 Marks)**

ii. A sample of 30 cm^2 cross sectional area and 18 cm long was tested in a constant head permeameter. Under a head of 50 cm, the discharge was 100 ml in 5 min. The dry weight of sand used for the test was 1100 g, and Specific gravity Gs = 2.7. Determine;

i. the hydraulic conductivity in cm/sec **(4 Marks)**
ii. the discharge velocity **(4 Marks)**
iii. the seepage velocity. **(6 Marks)**

Question Four (20 Marks)

A 3m layer of sand, of saturated unit weight 18kN/m^3, overlies a 4m layer of clay, of saturated unit weight 20kN/m^3. If the groundwater level occurs within the sand at 2m below the ground surface and assuming that the sand above groundwater level is saturated;

i. Represent the above soil condition with the aid of a diagram. **(5 Marks)**
ii. Determine the total vertical stress at the centre of the clay layer. **(5 Marks)**
iii. Calculate the effective vertical stress. **(4 Marks)**
iv. Explain total stress, effective stress and pore pressure. **(6 Marks)**

Equations

$$I_D = \frac{e_{max} - e}{e_{max} - e_{min}}$$

$$C_z = \frac{D^2{}_{30}}{D_{60} D_{10}}$$

$$C_u = \frac{D_{60}}{D_{10}}$$

$$I_L = \left(\frac{w - PL}{PI}\right)$$

$$\sigma_{total} = \sigma' + u$$

$$\sigma = \sum \gamma_i . z$$

$$e = n/(1-n)$$

$$G_S = \frac{M_S}{V_S \rho_W} = \frac{\rho_S}{\rho_W}$$

$$A = \frac{V_a}{V} = \frac{e - wG_S}{1+e}$$

$$A = n(1 - S_r)$$

$$\gamma = \frac{G_s(1+w)}{1+e}\gamma_w$$

$$\gamma = \frac{G_S + S_r\, e}{1+e}\gamma_W$$

$$v_s = \frac{v}{n} = \left(\frac{1+e}{e}\right)v$$

$$S_r = \frac{V_W}{V_v} = \frac{wG_S}{e}$$

$$n = \frac{V_v}{V_S + V_v} = \frac{e}{1+e}$$

$$\rho_{sat} = \frac{G_S + e}{(1+e)}\rho_W$$

$$\rho_d = \frac{G_S}{(1+e)}\rho_W$$

$$A = n(1 - S_r)$$

$$\rho = \frac{M}{V} = \frac{G_S(1+w)\rho_S}{(1+e)}$$

$$\rho = \frac{G_S + S_r\, e}{(1+e)}\rho_W$$

$$k = \frac{ql}{Ah}$$

$$k = \frac{al}{At_1}\ln\frac{h_0}{h_1}$$

$$= 2.3\frac{al}{At_1}\log\frac{h_0}{h_1}$$

$$i = \frac{h}{L}$$

$$q = vA = Aki$$

$$v = ki$$

$$\gamma_d = \frac{\gamma}{1+w}$$

$$m_v = -\frac{\Delta e}{\Delta p(1+e_1)}$$

$$Cc = \frac{e_1 - e_2}{\log_{10} p_2 - \log_{10} p_1}$$