(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

(Main Campus)

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF

BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 222

COURSE TITLE: SOIL MECHANICS I

DATE: 02 AUGUST 2022 **TIME: 11.AM. – 1 PM.**

Instructions to Candidates

- This paper contains FOUR (4) questions
- Answer ALL questions in Section A and **ANY** TWO (2) in Section B

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over ⟶

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

Question One

a) A sample of wet soil was extruded from a sampling tube of diameter 100 mm in a soil testing laboratory. The length of extruded sample was 200 mm. The mass of the wet soil was 3.15 kg. Following a water content determination, the mass of the dry soil was found to be 2.82 kg. Determine the;

i. Bulk density **(4 marks)**
ii. Water content **(3 marks)**
iii. Dry density **(3 marks)**
iv. Dry unit weight of the soil **(3 marks)**

b) In a constant head permeameter test the following results were obtained:

- Duration of test = 4.0 min
- Quantity of water collected = 300 ml
- Head difference in manometer = 50 mm
- Distance between manometer tappings = 100 mm
- Diameter of test sample = 100 mm

Determine the coefficient of permeability in m/s. **(7 marks)**

c) With the aid of diagrams, illustrate how the following soil mechanics tests are performed in the laboratory and state their significance;

i. Cone penetrometer test **(5 marks)**
ii. Sand replacement density test **(5 marks)**

SECTION B **(Answer TWO questions)**

Question Two **(20 Marks)**

a) For the soil profile in figure Q2. below, determine the total vertical stress, pore water pressure, and effective vertical stress and plot the stress distribution diagram.

(20 marks)

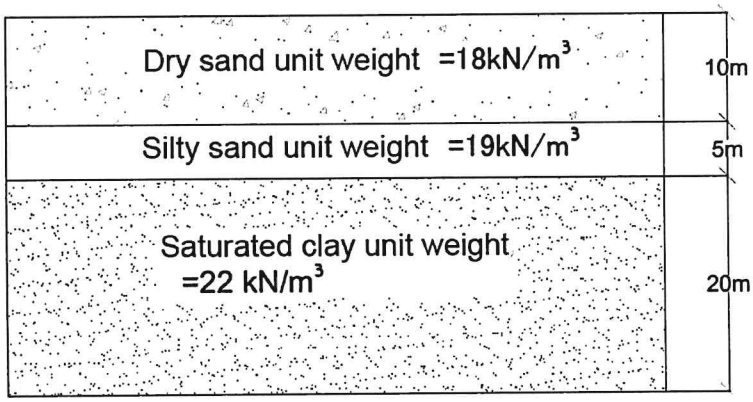

Figure Q2

Question Three **(20 Marks)**

A BS cone penetrometer test was carried out on a sample of clay with the following results:

Cone Penetration (mm)	16.1	17.6	19.3	21.3	22.6
Water Content (%)	50.0	52.1	54.1	57.0	58.2

The results from the plastic limit test were:

Test No.	**Mass of Tin (g)**	**Mass of tin wet soil + tin (g)**	**Mass of dry soil + tin (g)**
1	8.1	20.7	18.7
2	8.4	19.6	17.8

Determine the liquid limit, plastic limit and the plasticity index of the soil. **(20 marks)**

Question Four **(20 Marks)**

a) A sample, 18 cm long with a cross sectional of $30cm^2$ was tested in a constant head permeameter. The discharge was 100 ml in 5 min under a head of 50 cm. 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)**

b) Represent the test in (a) above using a diagram. **(6 Marks)**

Equations

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

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

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

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

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

$$\sigma = \sum \gamma_t . z$$

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

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

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

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

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

$$\gamma = \frac{G_s + S_r e}{1+e}\gamma_w$$

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

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

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

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

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

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

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

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

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

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

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

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

$$q = vA = Aki$$

$$v = ki$$

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

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

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