Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER 1
SESSION 2019/2020

COURSE NAME	:	GEOTECHNIC 1
COURSE CODE	:	BFC 21702
PROGRAMME	:	BFF
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Briefly describe the methods to determine the following indices for soil classification purposes

(i) the liquid limit

(2 marks)

(ii) the plastic limit

(2 marks)

(b) There are two common classification system used in Malaysia to classify a soil are the Malaysian/ British Soil Classification System (BSCS) and the Unified Soil Classification System (USCS). List **TWO (2)** major differences in both the systems.

(4 marks)

(c) Grain size distribution curve of a soil is as shown in **FIGURE Q1 (c)**. The liquid and the plastic limit of the soil are 58% and 34% respectively. Based on the gradation curve and the indices of the soil, determine:-

(i) D_{60}, D_{30}, and D_{10},

(3 marks)

(ii) The coefficient of uniformity (C_u) and the coefficient of curvature (C_c)

(5 marks)

(iii) Classify the soil based on the Unified Soil Classification System (USCS).

(4 marks)

Q2 (a) Define the following terms with the aid of appropriate soil phase diagram:

(i) Void ratio , e (1 mark)

(ii) Porosity , n (1 mark)

(iii) Degree of saturation, S_r (1 mark)

(iv) Unit weight, γ (2 marks)

(v) Moisture Content, w (2 marks)

(b) An unsaturated soil sample with the dimensions of 0.2 m x 0.2 m x 0.2 m has a weight of 0.02 kN and the moisture content of 22%. If the specific gravity (G_s) of the soil is 2.65. Calculate the bulk unit weight,γ_b (kN/m^3), dry unit weight, γ_d (kN/m^3), void ratio (e), and porosity (n).

(8 marks)

(c) A sample of soil has a water content of 27% and a bulk density of 1.97 Mg/m^3. Determine the dry density, void ratio and the specific gravity of the soil.

(5 marks)

Q3 (a) Compaction is the densification of soil by removal of air, which requires mechanical energy. Briefly explain the factors that affecting compaction.

(4 marks)

(b) List the methods to determine the field unit weight of soil compaction.

(2 marks)

(c) Discuss the method of compaction of cohesion less soil and cohesive soils

(4 marks)

(d) Laboratory compaction test results on a clayey soil are listed in **TABLE 1**. Following are the result of a field unit weight determination test on the same soil with sand cone method.

Calibrated dry density of sand	=	1570 kg/m^3
Calibrated mass of sand to fill the cone	=	0.545 kg
Mass of cylinder + cone + sand (before use)	=	7.59 kg
Mass of cylinder + cone + sand (after use)	=	4.78 kg
Mass of moist soil from hole	=	3.007 kg
Moisture content of moist soil	=	10.2%

Determine:

(i) Dry unit weight of compaction in the field.

(7 marks)

(ii) Relative compaction in the field.

(3 marks)

Q4 (a) Describe briefly with a sketch, the constant head permeameter.

(5 marks)

(b) A permeameter has a diameter of 75mm and the length of the soil sample is 150mm. The diameter of the standpipe is 15mm. During the test, the head was decreased from 1300 mm to 80 mm in 135 s. Calculate the coefficient of permeability of the soil.

(6 marks)

(c) **TABLE 2** shows the two falling head permeability test performed on different soils. From the results, determine the coefficient of permeability of each of these soil in mm/s.

(9 marks)

Q5 (a) Briefly explain with aid of appropriate diagram, what is the effective stress in saturated soils with upward and downward seepage.

(5 marks)

(b) **FIGURE Q5 (b)** shows a layer of soil in a tank with upward seepage.

Given: hydraulic conductivity of soil, k = 0.13 c m/s, H_1 = 1.5 m, H_2 =2.5 m, h = 1.5 m, γ_{sat} = 18.6 kN/m^3. Based on the data given:

(i) Explain the critical hydraulic gradient in soil for the upward water seepage through a soil mass.

(3 marks)

(ii) Calculate the upward seepage force per unit volume of soil.

(4 marks)

(iii) Determine the rate of upward seepage of water if the area of tank is 0.52 m^2. Give the answer in m^3 /min.

(3 marks)

(c) **FIGURE Q5 (c)** shows the soil profile for silty sand and clay layer. The moist unit weight of silty sand is 15.0 kN/m^3 while saturated unit weight for silty sand and clay layer are 16.8 kN/m^3 and 17.2 kN/m^3, respectively. Calculate the total stress at point A,B and C.

(5 marks)

Q6 (a) There are three types of triaxial test which are Unconsolidated Undrained (UU), Consolidated Undrained (CU) and Consolidated Drained (CD). Briefly describe any one of the triaxial test mentioned above and shear strength parameters obtained by conducting the test.

(4 marks)

(b) The in-situ shear strength of a soil can be determined directly or indirectly by conducting in-situ shear strength tests such as field Vane Shear Test (VST), Cone Penetration Test (CPT), Standard Penetration Test (SPT), JKR Probe Test, and many others. Describe briefly any one of the test and relate the values obtained from the test to the shear strength of the soil.

(4 marks)

(c) A specimen of saturated sand was consolidated under a confining pressure of 82.8 kN/m^2. The axial stress was increased and the drainage was closed. The specimen failed when the axial deviator stress reached 62.8 kN/m^2. The pore water pressure at failure condition was 46.9 kN/m^2.

(i) Determine the drained and the undrained angle of friction.

(6 marks)

(ii) Determine the deviator stress at failure, if a drained test was conducted with the same confining pressure (82.8 kN/m^2)

(6 marks)

- END OF QUESTIONS –

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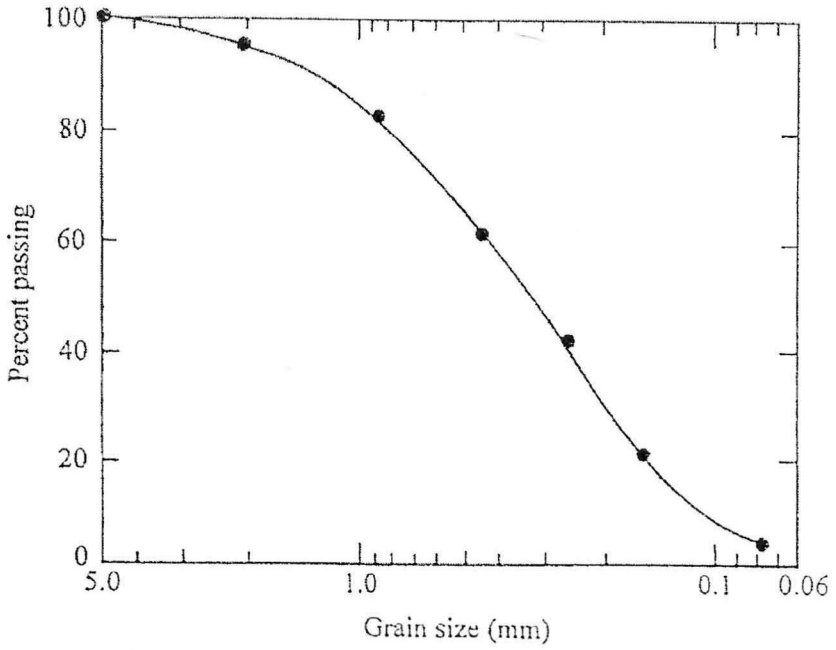

FIGURE Q1 (c): Grain size distribution curve

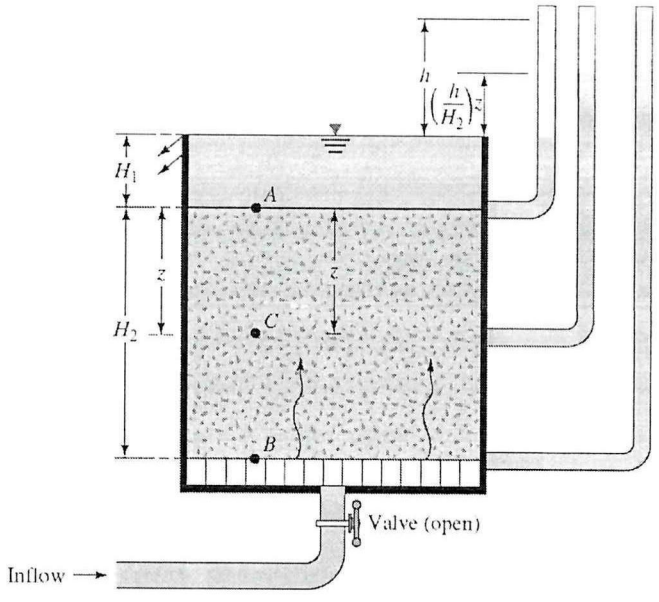

FIGURE Q5 (b): Layer of soil in tank with upward seepage

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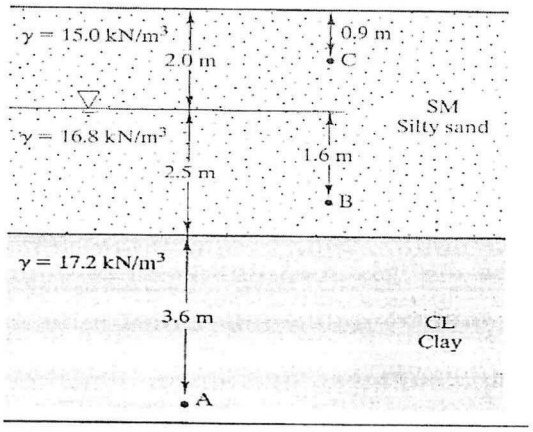

FIGURE Q5 (c): Soil profile

TABLE 1: Results of compaction test

Moisture content (%)	Moist Unit weight (kN/m^3)
6	15.69
8	18.85
9	20.19
11	20.98
12	20.72
14	19.27

TABLE 2: Falling Head results

Standpipe area	400 mm^2	
Permeameter sample area	2800 mm^2	
Permeameter sample height	50 mm	
Initial water head standpipe	1000 mm	
Final water head in standpipe	200 mm	
Time for decreasing the water head	Soil 1	500s
	Soil 2	15s

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List of formula given:

$$k = \frac{QL}{Aht} \qquad k = \frac{q}{Ai}$$

$$k = 2.303 \frac{aL}{At} \log_{10} \frac{h_1}{h_2}$$

$$k_{H(eq)} = \frac{1}{H}\left(k_{H_1} H_1 + k_{H_2} H_2 + ...k_{H_n} H_n\right)$$

$$k_{v(eq)} = \frac{H}{\left(\frac{H_1}{k_{v_1}}\right) + \left(\frac{H_2}{k_{v_2}}\right) + ... \left(\frac{H_n}{k_{v_n}}\right)}$$

$$\sigma_1 = \sigma_3 \tan^2\left(45^\circ + \frac{\phi}{2}\right) + 2c \tan\left(45^\circ + \frac{\phi}{2}\right)$$

$$\sigma_3 = \sigma_1 \tan^2\left(45^\circ - \frac{\phi}{2}\right) - 2c \tan\left(45^\circ - \frac{\phi}{2}\right)$$

$$\sigma_n = \frac{\sigma_1 + \sigma_3}{2} + \frac{\sigma_1 - \sigma_3}{2} \cos 2\theta \qquad q_t = A k_{eq} i$$

$$\tau_f = \frac{\sigma_1 - \sigma_3}{2} \sin 2\theta$$