UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	GEOTECHNICS I
COURSE CODE	:	BFC 21702
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN PART A AND ANY **THREE (3)** QUESTIONS FROM PART B

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

PART A

Q1 (a) Briefly explain **TWO (2)** main differences between the shear parameters obtained from direct shear test and those obtained from unconfined compression test.

(6 marks)

(b) (i) What are the drained conditions and undrained conditions in determining the shear parameters?

(4 marks)

(ii) Volume change is expected on the samples when sheared at drained conditions. Distinguish the differences in volume change of loose samples and dense samples when sheared at drained conditions.

(6 marks)

(c) Consolidated Undrained (CU) triaxial tests were carried out to determine the shear parameters of a 5m thick saturated clay layer (γ_{sat} = 18.5 kN/m^3) at the nearby construction site. The results of the tests are shown in **TABLE Q1**.

TABLE Q1

Test No.	Cell pressure, σ_3 (kN/m^2)	Deviator stress at failure, $(\Delta\sigma_d)_f$ (kN/m^2)	Pore pressure at failure, $(\Delta u)_f$ (kN/m^2)
1	100	170	-15
2	200	260	-40
3	300	360	-80

(i) Determine the Mohr Coulomb's shear strength parameters c', ϕ' and c, ϕ graphically.

(5 marks)

(ii) Calculate the shear strength of the soil in the middle of clay layer.

(4 marks)

PART B

Q2 (a) State the **THREE (3)** major categories of particle shape? Briefly explain the expected changes in particle shape on sand particles carried by wind and water for a long distance when compared with the sand particles located close to their origin.

(6 marks)

(b) Given that:

- The moist mass of a soil specimen is 20.7 kg.
- The specimen's volume measured before drying is 0.011 m^3.
- The specimen's dried mass is 16.3 kg.
- The specific gravity of solids is 2.62.

Determine:

(i) Void ratio, e and porosity, n

(4 marks)

(ii) Degree of saturation, Sr

(3 marks)

(iii) Wet unit mass (kg/m^3)

(4 marks)

(iv) Dry unit mass (kg/m^3)

(4 marks)

(v) Wet unit weight (kN/m^3)

(2 marks)

(vi) Dry unit weight (kN/m^3)

(2 marks)

Q3 (a) List **TWO (2)** benefits of the soil compaction in the field.

(2 marks)

(b) The laboratory compaction test can be performed using either standard Proctor method or modified Proctor method.

(i) Describe any **TWO (2)** differences between the standard and modified Proctor test.

(4 marks)

(ii) Explain **ONE (1)** main criterion for one to select suitable laboratory compaction method.

(4 marks)

(c) You are an earthwork construction control inspector checking the field compaction of a layer of soil. The laboratory compaction data for the soil is shown in **TABLE Q3**. Specification call for the compacted density to be at least 95% of the maximum laboratory value and within ± 2% of the optimum water content. When you did the sand cone test, the volume of soil excavated was 1.165 x 10^{-3} m^3, the dry weight is 0.019 N and the specific gravity is 2.65.

(i) Plot the compaction curve and determine the maximum dry density and optimum moisture content.

(4 marks)

(ii) Plot the 0% and 5% air void curve in the compaction curve.

(4 marks)

(iii) Calculate the relative compaction and decide whether the compacted soil layer meet the specification.

(4 marks)

(iv) Please suggest necessary action to be taken if the compaction does not meet the specification.

(3 marks)

Q4 (a) In most fluid flow applications the total head is the sum of elevation head, pressure head and velocity head.

The velocity head is always assumed as zero in groundwater flow. Justify the basis of this assumption.

(4 marks)

(b) With the aid of sketches, briefly explain the differences between falling head test and constant head test.

(5 marks)

(c) A falling head permeability test is to be performed on a soil whose permeability is estimated to be 2.8 x 10^{-6} m/s. The sample's cross section is 12 cm^2 and its length is 7.4 cm.

Calculate the diameter of standpipe should be use if the head of water is required to drop from 31.2 cm to 19.4 cm in 5 mins.

(6 marks)

(d) An unconfined aquifer with a saturated thickness of 15 m. Observation wells are located at distances of 60 m (observation A) and 120 m (observation B) from the pumping well. Water is pumped from the well at a rate of 0.008 m^3/s. After pumping 16 hours, the following drawdown information was collected: the drawdown was recorded as 0.41 m at observation A, and drawdown was 0.24m at observation B.

Determine the hydraulic conductivity, k in m/s.

(10 marks)

Q5 (a) State the changes in pore water pressure when:

(i) Water seeping upward

(ii) Water seeping downward

(8 marks)

(b) Briefly explain the phenomenon referred as "quick condition" and its mechanism of occurrence when soil subjected to upward seeping of water.

(7 marks)

(c) It is reported that upward seepage is taking place through granular soil contained in a tank as shown in **FIGURE Q5**.

Given that:

Thickness of water above granular soil, $H_1 = 1.8$ m,

Thickness of granular soil, $H_2 = 2.3$ m,

Height of water head in manometer, $h = 1.8$ m,

Area of tank, $A = 0.7\ m^2$,

Void ratio of the soil, $e = 0.48$

Specific gravity of soil, $Gs = 2.65$

Permeability of soil, $k = 0.22$ cm/s

(i) Determine the rate of upward seepage, q in cm^3/s.

(3 marks)

(ii) Discuss whether "quick condition" will occur in this case.

(3 marks)

(iii) Determine the critical value of h to cause "quick condition".

(4 marks)

- END OF QUESTION -

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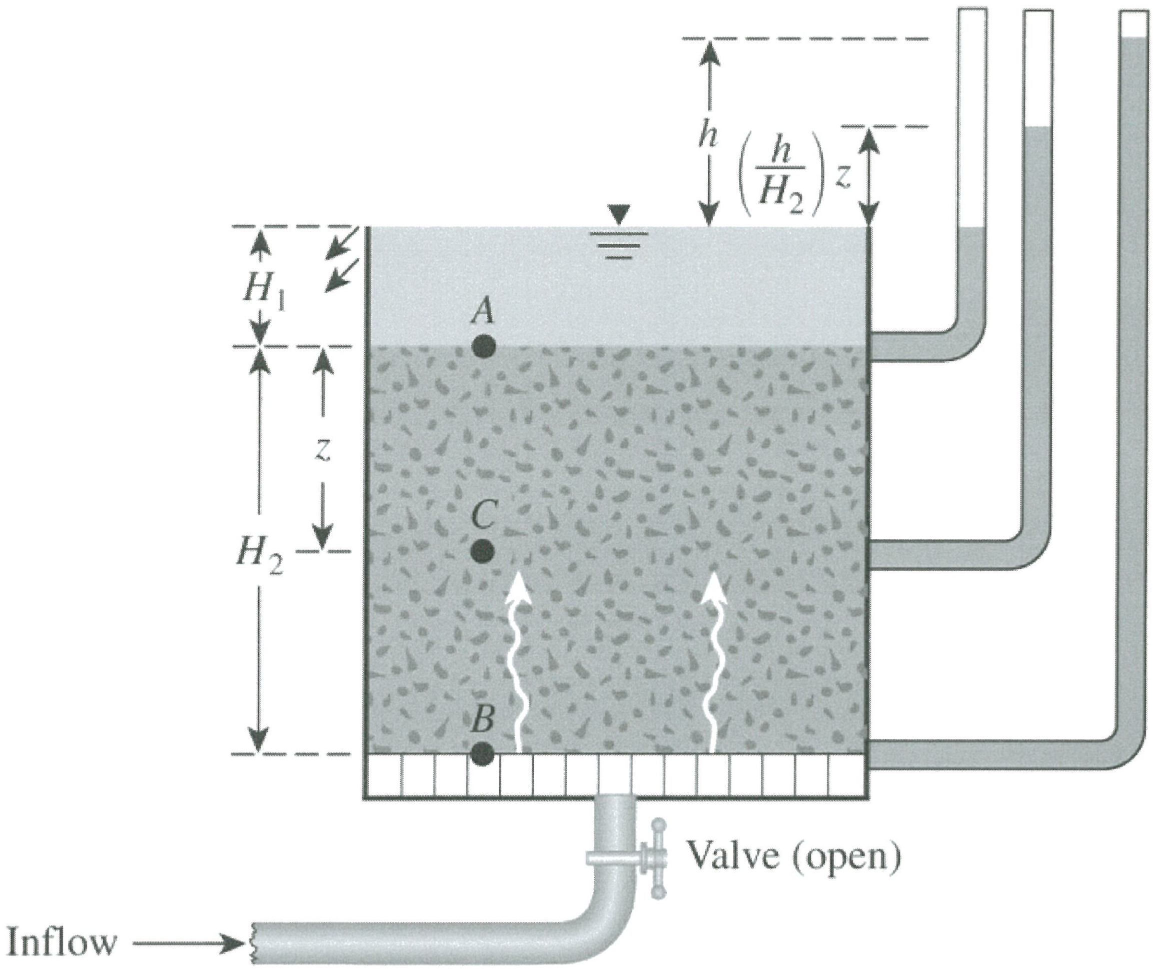

FIGURE Q1

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TABLE Q3: Results from compaction test

Moisture content (%)	Dry unit weight (kN/m^3)
5.3	16.9
7.4	18.0
8.9	18.4
11.3	18.3
13.7	17.5

List of formula:

$$R = \frac{\gamma_{d(field)}}{\gamma_{d(\max-lab)}} \; ; \; Dr = \left[\frac{\gamma_{d(field)} - \gamma_{d(\min)}}{\gamma_{d(\max)} - \gamma_{d(\min)}}\right]\left[\frac{\gamma_{d(\max)}}{\gamma_{d(field)}}\right]$$

Dry density for plotting Zero air void, and 5% air Void

$$\rho_d = \frac{1 - \frac{V_a}{100}}{\frac{1}{\rho_s} + \frac{W}{100_{\rho w}}}$$

where

ρ_d is the dry density (in Mg/m^3);

ρ_s is the particle density (in Mg/m^3);

ρ_w is the density of water (in Mg/m^3), assumed equal to 1;

V_a is the volume of air voids in the soil, expressed as a percentage of the total volume of the soil (equal to 0 %, 5 %, 10 % for the purpose of this plot);

w is the moisture content (in %).

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

$$k = \frac{2.303q\log_{10}\left(\frac{r_1}{r_2}\right)}{\pi\left(h_1^2 - h_2^2\right)}$$

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Various forms of relationship for γ, γ_d and γ_{sat}

Moist unit weight (γ)		Dry unit weight (γ_d)		Saturated unit weight (γ_{sat})	
Given	**Relationship**	**Given**	**Relationship**	**Given**	**Relationship**
w, G_s, e	$\frac{(1+w)G_s\gamma_w}{1+e}$	γ, w	$\frac{\gamma}{1+w}$	G_s, e	$\frac{(G_s+e)\gamma_w}{1+e}$
S, G_s, e	$\frac{(G_s+Se)\gamma_w}{1+e}$	G_s, e	$\frac{G_s\gamma_w}{1+e}$	G_s, n	$[(1-n)G_s+n]\gamma_w$
w, G_s, S	$\frac{(1+w)G_s\gamma_w}{1+\frac{wG_s}{S}}$	G_s, n	$G_s\gamma_w(1-n)$	G_s, w_{sat}	$\left(\frac{1+w_{sat}}{1+w_{sat}G_s}\right)G_s\gamma_w$
w, G_s, n	$G_s\gamma_w(1-n)(1+w)$	G_s, w, S	$\frac{G_s\gamma_w}{1+\left(\frac{wG_s}{S}\right)}$	e, w_{sat}	$\left(\frac{e}{w_{sat}}\right)\left(\frac{1+w_{sat}}{1+e}\right)\gamma_w$
S, G_s, n	$G_s\gamma_w(1-n)+nS\gamma_w$	e, w, S	$\frac{eS\gamma_w}{(1+e)w}$	n, w_{sat}	$n\left(\frac{1+w_{sat}}{w_{sat}}\right)\gamma_w$
		γ_{sat}, e	$\gamma_{sat}-\frac{e\gamma_w}{1+e}$	γ_d, e	$\gamma_d+\left(\frac{e}{1+e}\right)\gamma_w$
		γ_{sat}, n	$\gamma_{sat}-n\gamma_w$	γ_d, n	$\gamma_d+n\gamma_w$
		γ_{sat}, G_s	$\frac{(\gamma_{sat}-\gamma_w)G_s}{(G_s-1)}$	γ_d, G_s	$\left(1-\frac{1}{G_s}\right)\gamma_d+\gamma_w$
				γ_d, w_{sat}	$\gamma_d(1+w_{sat})$