UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	GEOTECHNICS I
COURSE CODE	:	BFC 21702
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS OF PART A AND ANY **TWO (2)** QUESTIONS OF PART B

TERBUKA

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

PART A

Q1 (a) Describe the triaxial compression test for the determination of the shearing resistance of soils, explaining the principles of **THREE (3)** types of test which are commonly conducted.

(6 marks)

(b) Describe the essential features of the direct shear test and discuss typical results obtained from the direct shear test conducted on loose sand.

(6 marks)

(c) The shear strength of soil can be determined in the laboratory and in-situ. The in-situ test has the advantages compared to laboratory testing and it can be performed using various methods.

(i) List **THREE (3)** advantages and **TWO (2)** disadvantages of shear strength test in the field.

(5 marks)

(ii) List **FIVE (5)** field methods for determining the shear strength in-situ.

(5 marks)

(d) Shear box test result on compacted sand is shown in **Table 1.**

(i) If the shear box is 60 mm^2, estimate the shear strength parameters of the compacted sand.

(8 marks)

(ii) Determine whether the failure occur on a plane within this soil at a point where the normal stress is 320 kN/m^2 and the corresponding shear stress is 138 kN/m^2.

(4 marks)

(iii) If an unconsolidated undrained triaxial test is carried out on a specimen of a similar soil with a cell pressure of 160 kN/m^2, find the total axial stress at which failure would be expected.

(6 marks)

PART B

Q2 (a) Discuss the differences between the Unified Soil Classification System and AASHTO soil classification system

(5 marks)

(b) Mechanical analysis on three different samples denoted as A, B and C were carried out in a soil laboratory. The results of tests are given in **Table 2.** The soil is non plastic.

(i) Plot the particle size distribution of sample A, B and C on the semi log graph in Figure **Q2(b)(i).**

(6 marks)

(ii) Determine the effective size, coefficient of uniformity and coefficient of curvature of each sample.

(5 marks)

(iii) Classify the soils according to the Unified Soil Classification System in Figure **Q2(b)(iii).**

(4 marks)

(c) Earth is required to be excavated from borrow pits for building embankment as shown in Figure **Q2(c).** The wet unit weight of undisturbed soil of the borrow pits is 18 kN/m^3 and its water content is 8%, in order to build a 4 m high embankment with top width 2 m and side slope 1:1. Meanwhile, the dry unit weight required in the embankment is 15 kN/m^3 with a moisture content of 10%.

(i) Determine the volume of embankment per unit meter length.

(1 mark)

(ii) Calculate the the dry unit weight of soil in the borrow pit.

(2 marks)

(iii) Determine the volume of earth required to be excavated, V per meter from borrow pit for embankment with dry unit weight 15 kN/m^3.

(2 marks)

(iv) Calculate the void ratios and the degree of saturation of embankment at undisturbed state.

(5 marks)

Q3 (a) Explain briefly with a suitable table, the standard proctor compaction test and modified proctor compaction test.

(6 marks)

(b) The results of compaction test in the laboratory using the standard proctor method for the Batu Pahat residual soil are shown in Figure **Q3(b)**. After compaction of the soil in the laboratory, the field density tests using the sand cone replacement method were performed. The volume of soil excavated was 1165 cm^3 and the bulk weight and dry weight of the excavated soil are 2230 g and 1852 g respectively. According to JKR specifications, the relative compaction must be at least 95% and the moisture content should be within ±2% of optimum moisture content (w_{opt}). Assume the specific gravity, $G_s = 2.65$.

(i) Plot the 0%, 5% and 10% air void lines in Figure **Q3(b)** and determine the maximum dry density and optimum moisture content from compaction curve.

(8 marks)

(ii) Determine the relative compaction of the compacted soil.

(3 marks)

(iii) Does the compaction meet the JKR specification? Please explain.

(4 marks)

(iv) If the compacted layer in the field was 3 m, calculate the vertical stress (kN/m^3) at a depth of 2 m from the ground surface.

(3 marks)

(c) Figure **Q3(c)** shows a graph of compaction curves A, B and C for the same soil with varying compactive effort. Discuss the most efficient compaction condition to achieve $R\gamma_{d(max)}$. Your discussion should include the range of water content and the selected compaction curves.

(6 marks)

Q4 (a) Differentiate between falling head test and constant head test.

(4 marks)

(b) The soil layers below have a cross section of 100 mm x 100 mm each as shown in Figure **Q4(b)**. The permeability of each soil is: $k_A = 10^{-2}$ cm/sec.; $k_B = 3 \times 10^{-3}$ cm/sec; $k_C = 4.9 \times 10^{-4}$ cm/sec. Find the rate of water supply in cm^3/hr.

(9 marks)

(c) Consider the soil profile shown in Figure **Q4(c)**:

(i) Calculate the variations of σ, *u*, and *σ'* at points *A*, *B*, and *C*.

(11 marks)

(ii) How high should the groundwater table rise so that the effective stress at *C* is 111 kN/m^2?

(6 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER / SESSION : SEM II /2016/2017 PROGRAMME CODE: BFF
COURSE NAME : GEOTECHNICS I COURSE CODE : BFC 21702

TABLE 1: Results of Shear Box Test

Test No.	. Normal load (N)	Shear load (N)
1	360	260
2	720	380
3	1080	520
4	1440	640

TABLE 2: Results of sieve analysis of sample A, B and C

Samples ASTM Sieve Designation	Percentage Passing (%)		
	A	B	C
63.0 mm	100		93
20.0 mm	64		76
6.3 mm	39	100	65
2.0 mm	24	98	59
600 µm	12	90	54
212 µm	5	9	47
63 µm	1	2	34
20 µm			23
6 µm			7
2 µm			4

FINAL EXAMINATION

SEMESTER / SESSION : SEM II /2016/2017 PROGRAMME CODE: BFF
COURSE NAME : GEOTECHNICS I COURSE CODE : BFC 21702

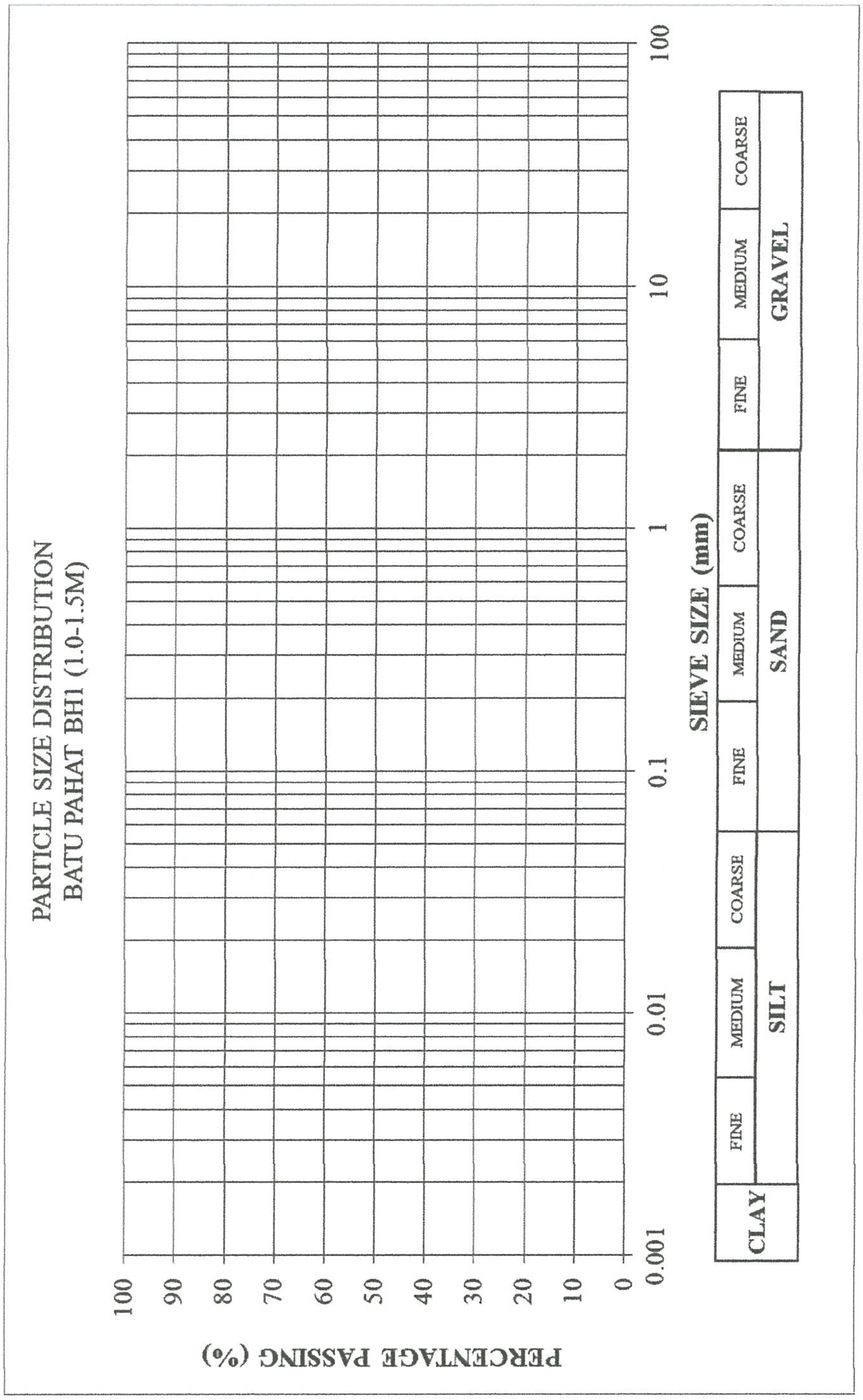

FIGURE Q2 (b)(i) : Particle size distribution chart according to British Standard

FINAL EXAMINATION

SEMESTER / SESSION : SEM II /2016/2017 PROGRAMME CODE: BFF
COURSE NAME : GEOTECHNICS I COURSE CODE : BFC 21702

Criteria for Assigning Group Symbols				Group Symbol
Coarse-Grained Soils More than 50% of retained on No. 200 sieve	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[c]	GW
			$C_u < 4$ and/or $1 > C_c > 3$[c]	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 4.2)	GM
			$PI > 7$ and plots on or above "A" line (Figure 4.2)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[c]	SW
			$C_u < 6$ and/or $1 > C_c > 3$[c]	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 4.2)	SM
			$PI > 7$ and plots on or above "A" line (Figure 4.2)	SC
Fine-Grained Soils 50% or more passes No. 200 sieve	**Silts and Clays** Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 4.2)[e]	CL
			$PI < 4$ or plots below "A" line (Figure 4.2)[e]	ML
		Organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit–not dried}} < 0.75$; see Figure 4.2; OL zone	OL
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 4.2)	CH
			PI plots below "A" line (Figure 4.2)	MH
		Organic	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit–not dried}} < 0.75$; see Figure 4.2; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a]Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.
[b]Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.
[c]$C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$
[d]If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 4.2, use dual symbol GC-GM or SC-SM.
[e]If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 4.2, use dual symbol CL-ML.

USCS	Boulders	Cobbles	Gravel		Sand			Fines (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	
	300	75	19	4.75	2.0	0.425	0.075	

FIGURE Q2 (b)(iii) : USCS Classification

FINAL EXAMINATION

SEMESTER / SESSION : SEM II /2016/2017 PROGRAMME CODE: BFF
COURSE NAME : GEOTECHNICS I COURSE CODE : BFC 21702

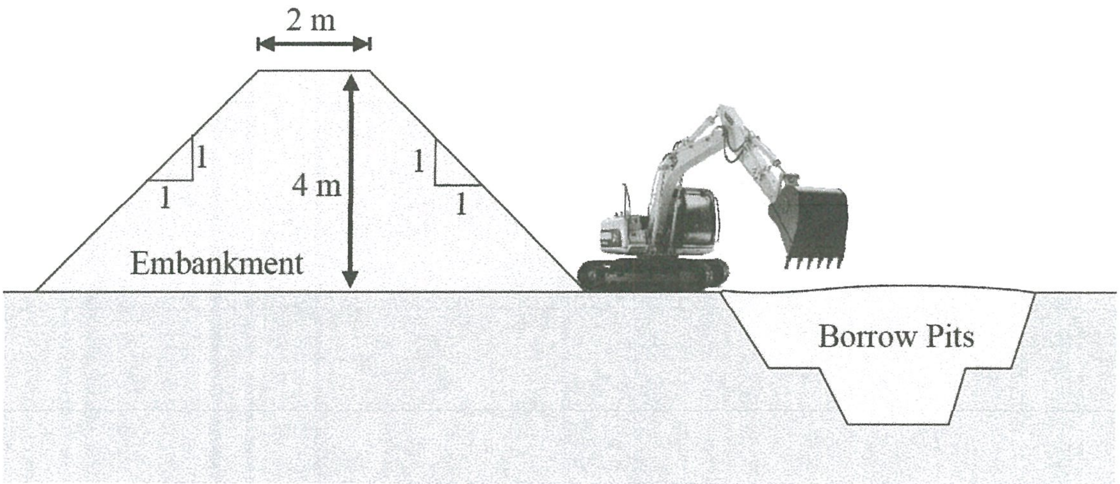

FIGURE Q2(c): Embankment structure and borrow pits

Given that:

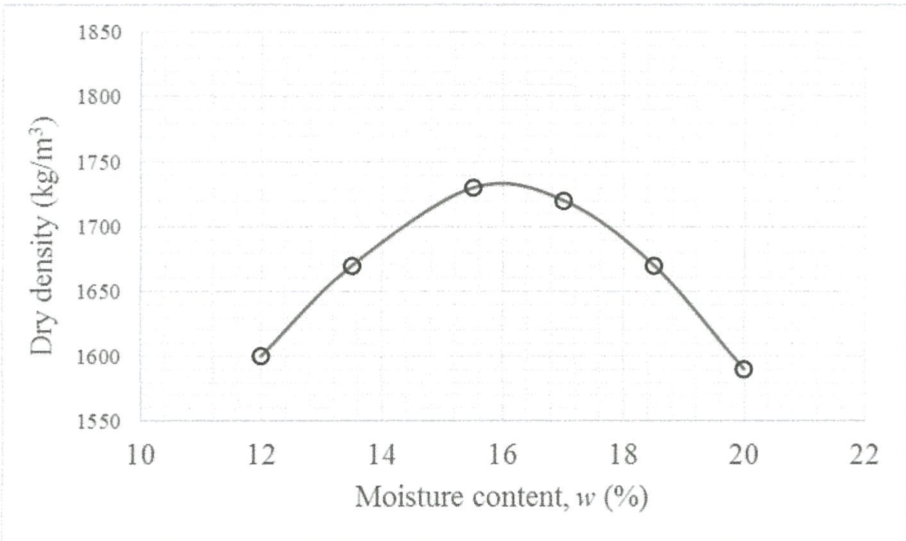

FIGURE Q3(b): Proctor test result

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II /2016/2017	PROGRAMME CODE:	BFF
COURSE NAME	: GEOTECHNICS I	COURSE CODE	: BFC 21702

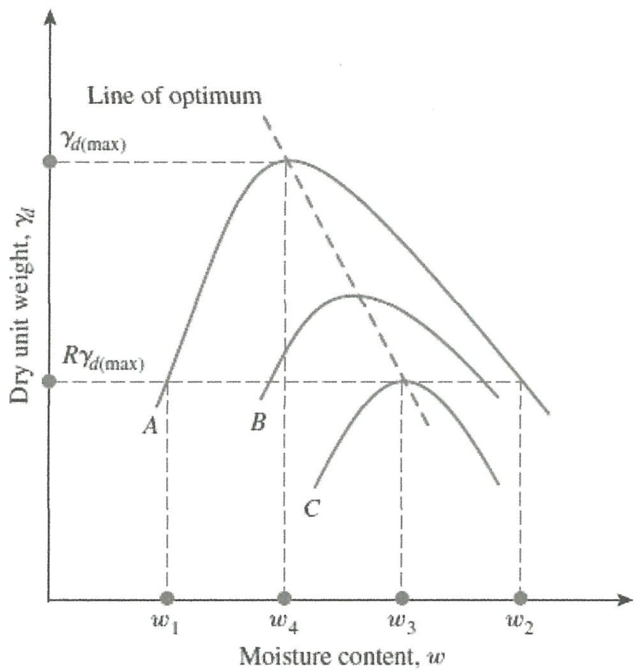

FIGURE Q3(c): Proctor test result for the same soil with varying compactive effort

FINAL EXAMINATION

SEMESTER / SESSION : SEM II /2016/2017 PROGRAMME CODE: BFF
COURSE NAME : GEOTECHNICS I COURSE CODE : BFC 21702

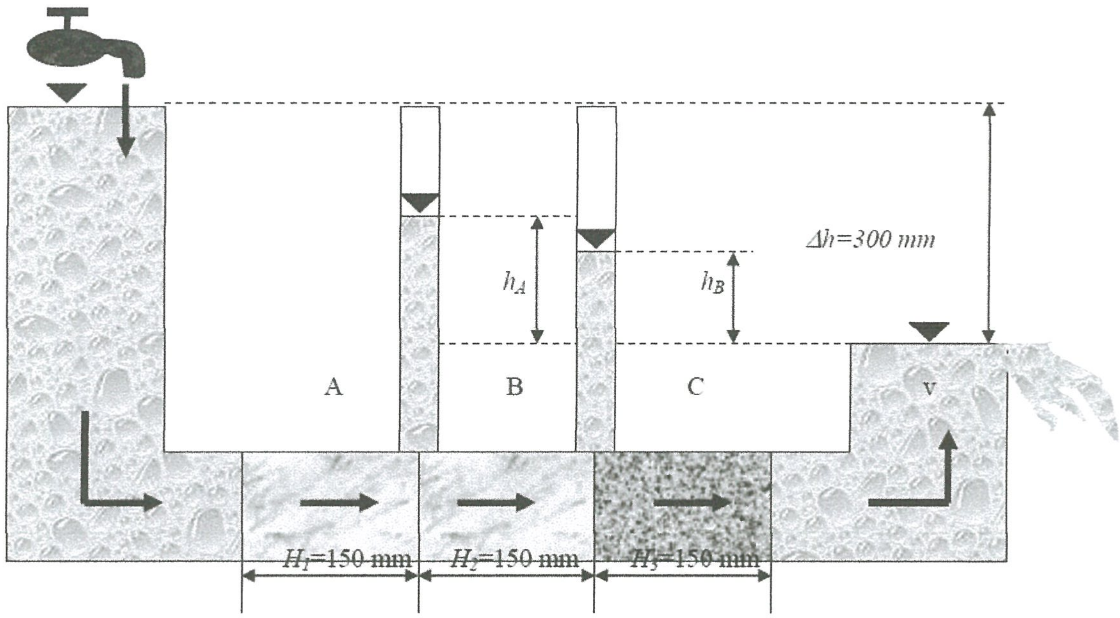

FIGURE Q4(b): Soil layer with different permeability

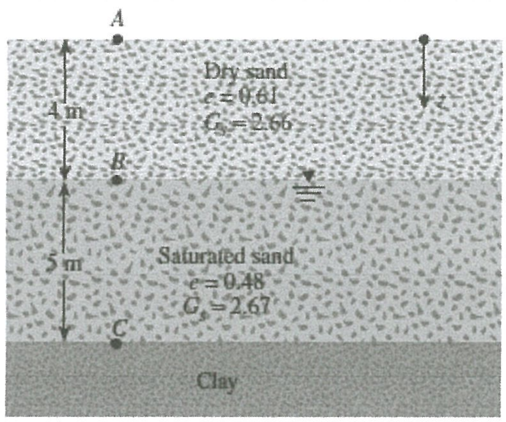

FIGURE Q4(c): Soil profile