UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2013/2014

COURSE NAME	:	GEOTECHNICAL TECHNOLOGY
COURSE CODE	:	DAB 20402
CO-HORT	:	2 DAB
EXAMINATION DATE	:	DECEMBER 2013/ JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER : (A) TWO (2) QUESTIONS FROM PART A (B) TWO (2) QUESTIONS FROM PART B

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

PART A

Q1. (a) Describe the standard dimensions of split barrel sampler

(4 marks)

(b) Evaluate the disturbances of soil sample if the diameter of the soil sample is 46 mm and the thickness of the sampler is 2.5mm

(6 marks)

(c) SPT readings on sandy soil with the depths are as shown in **Table 1**

Table 1 : SPT Readings with depths

Depths (m)	SPT readings	p_0	N_{corr}
5	6		
10	8		
15	11		
20	16		

If the unit weight of the soil is 18.6 kN/m^3. Let ground water level at 12 m deep. Calculate the following :

(i) Overburden pressure, p_0

(ii) Corrected SPT reading N_{corr}

(8 marks)

(d) Explain two (2) human errors that occur during the process of driving McIntosh / JKR probe.

(2 marks)

(e) A vane shear test has been done on the sample of marine clay from the campus of UTHM, the dimensions of the equipments and properties of the clay are as follows :

D=100mm, H=200mm, $i_T=i_B=25^\circ$ and has LL=85%, PL=38% and torque of 120 N-m

Calculate the value of corrected undrained shear strength, $s_{uv(corr)}$ of the clay.

(5 marks)

Q2 (a) Sketch and label pad footing

(5 marks)

(b) List three (3) factors that affect the allowable bearing pressures on non-cohesive soils

(3 marks)

(c) Describe water content at every soil phases below :

(i) Shrinkage limit
(ii) Plastic limit
(iii) Liquid limit

(6 marks)

(d) Sketch and label the location of limits for soft soil, phases and volume

(5 marks)

(e) A laboratory test on a fine grain soil, the following data was obtained LL = 45% ; PL = 18%, clay content = 24.2% (particle < 2 μm), natural water content is 29%.

Calculate the following

(i) Soil activity.

(ii) Consistency index

(iii) Liquidity index

(6 marks)

Q3 (a) **Table 2** as shown is the result of dry sieve test, calculate percent retained (column 3) and percent passing (column 4).

Table 2 : Result from dry sieve test

Particle size (mm)	Mass retained (g)	Percent retained (%)	Percent Passing (%)
6.3	0		
2	20		
0.6	100		
0.212	210		
0.063	300		
0.020	150		
0.006	110		
0.002	70		
pan	40		

(9 marks)

(b) From the result in Table 2, plot the curve of particle size versus percent passing.

(3 marks)

(c) From the curve, determine the following :

(i) D_{10} (ii) D_{30} (iii) D_{60}
(iv) C_u (v) C_c

(5 marks)

(d) **Table 3** shows the result of a proctor compaction test on a soil sample.

Table 3 : Dry density versus moisture content

Dry density (kg/m^3)	Water content (%)
1797	12.8
1862	14.5
1864	15.6
1833	16.8
1757	19.2

Sketch and evaluate the following :

(i) The optimum moisture content
(ii) Maximum dry density
(iii) Percent air-void at maximum dry density

(8 marks)

PART B

Q4 (a) Describe **two (2)** factors that affect permeabiity

(4 marks)

(b) Estimate the value of flow rate for the earth dam **in Figure Q3(b)** if the permeability of the soil taken as 4.69×10^{-9} cm/s,
$h = H_L = 5m$; $N_f=3$; $N_d=12$; $k=6.54 \times 10^{-8}$ m/s

(2 marks)

(c) A pumping of confined aquifer is accomplished in estimating the value of permeability of soil in the aquifer. After reaching an equilibrium, the following data is obtained :

- Rate of discharge = 900 liter/min.
- Water level $h_1 = 4.5$ m and $h_2 = 8$ m at the distance of $r_1 = 10$ m and $r_2 = 75$ m.
- Thickness of aquifer = 10 m.

Water level before pumping was 2m.

Hint : $q = 750l/\min = 0.0125m^3/s$

(i) Sketch and label the above problem with unscaled figure.

(8 marks)

(ii) Calculate k

(2 marks)

(iii) Recalculate if the problem is unconfined quifer. Use the same parameters

(3 marks)

(d) Sketch and label falling head test apparatus

(6 marks)

Q5 (a) Sketch and label the theoretical intersection of flow line and equipotential line.

(2 marks)

(b) Discuss the concept of local and general shear. Sketching and labelling that explain your answer is encouraged.

(4 marks)

(c) When an unconfined compression test is conducted on a cylinder of soil, it fails under axial stress of 2.0 kg/cm^2. The failure plane makes an angle of 55° with the horizontal.

Sketch a scaled figure and evaluate the following :

(i) Cohesion
(ii) Angle of shearing resistance of the soil sample.

(8 marks)

(d) A direct shear test is completed on the soil sample obtained from the residual soil deposit at Bukit Perdana and the data are given in **Table 4**.

(i) Sketch and label the failure line of normal vs shear stress

(9 marks)

(ii) Determine the value of cohesion and internal friction of the soil

(2 marks)

Q6 (a) Describe the concept of consolidation by using the general shape of the plot of deformation of the specimen versus time for a given load increment.

(6 marks)

(b) **Table 5** shows the result of a consolidation test on a soft marine clay soil. Each pressure increment having been maintained for 24 hours.

After it had expanded for 24 hours the sample was removed from the apparatus and found to have a moisture content of 22 per cent. The particle specific gravity of the soil was 2.67.

(i) Plot the void-ratio to effective pressure curve

(6 marks)

(ii) Plot the thickness vs pressure curve

(6 marks)

(iii) Calculate the value of the coefficient of volume change for a pressure range of 250 – 650 kPa
From it:

(3 marks)

(c) Calculate the consolidation settlement, if a layer of this clay is 15 m in thick.

(4 marks)

END OF QUESTION

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LIST OF FORMULA :

Q1 : $A_r = \left(\frac{D_{ext}^{\ 2} - D_{\text{int}}^{\ 2}}{D_{\text{int}}^{\ 2}} \right) \times 100\%$ $p'_0 = \gamma' z$; $C_N = 0.77 \log_{10} \frac{1915}{p_0}$ *where* $\left(p_0 \text{ in } \frac{kN}{m^2} \right)$;

$N_{corr} = C_N N_F$; $s_{uv} = \frac{12T}{\pi D^2 \left[\left(\frac{D}{\cos i_T} \right) + \left(\frac{D}{\cos i_B} \right) + 6H \right]}$;

Q2 : $A = \frac{PI}{\%\ clay\ particle\ (< 2\mu m)}$; $I_c = \frac{LL - w}{I_p}$ $I_L = \frac{w - PL}{I_P}$;

Q3 : $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{(D_{60})(D_{10})}$; $\rho_d = \frac{G_s \rho_w}{1 + wG_s}(1 - A_v)$;

Q4 : $q = \frac{khN_f}{N_d}$; $k = \frac{q \ln\left(\frac{r_2}{r_1} \right)}{2\pi H(h_2 - h_1)}$ $k = \frac{q \ln\left(\frac{r_2}{r_1} \right)}{\pi(h_2^2 - h_1^2)}$;

Q6: $m_v = \frac{dH}{H_0} \times \frac{1}{d\sigma_v}$; $S_c = m_v d\sigma_v H$

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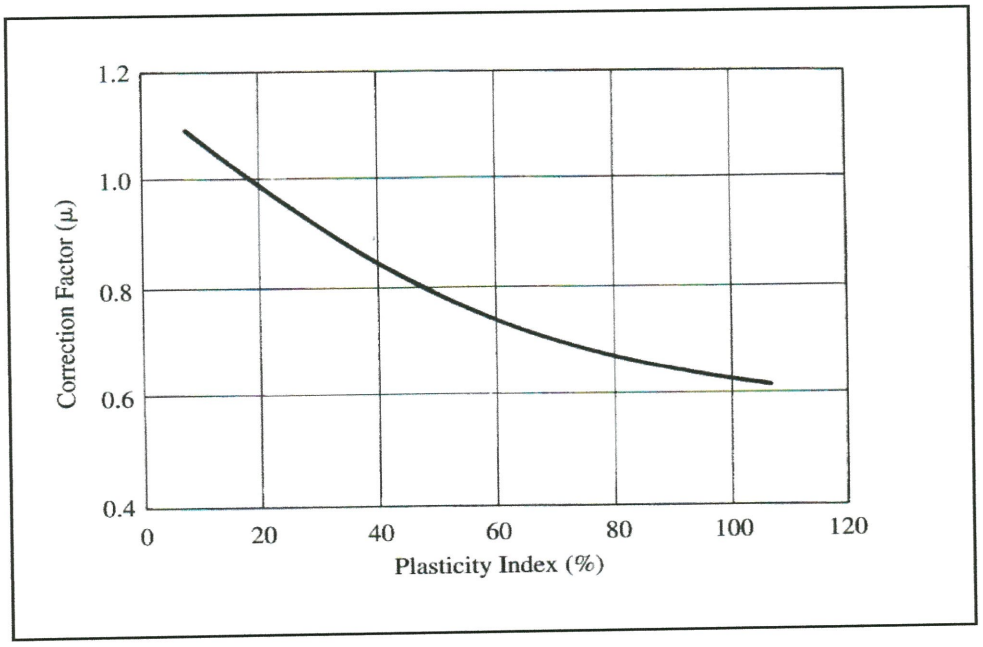

Figure Q1(e): Correction factor μ vs PI

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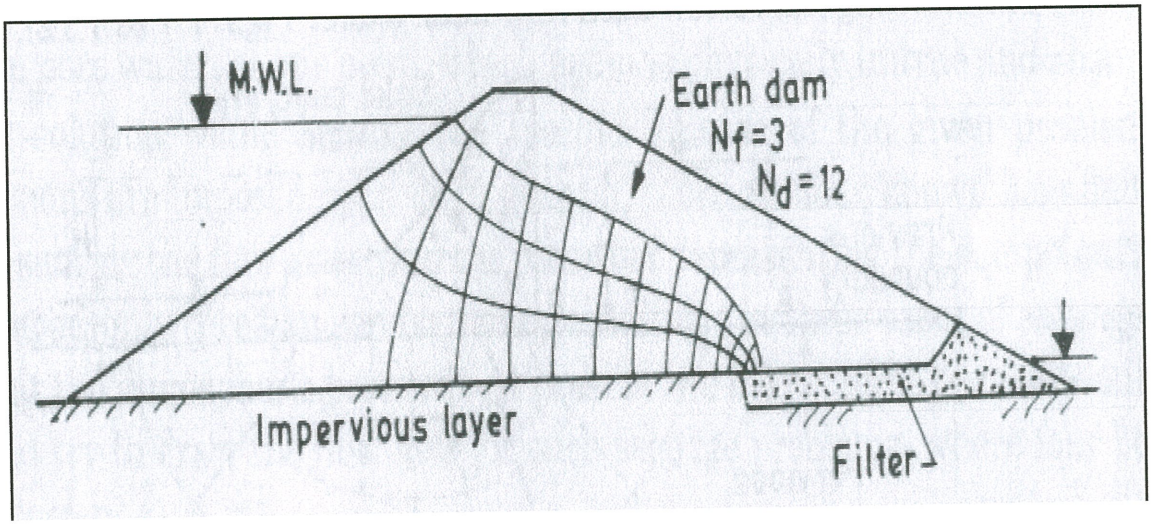

Figure Q4(b): Flow net for steady seepage through an earth dam

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Table 4: Value of normal stress vs shear stress

Sample Number	Normal stress (kN/m2)	Shear stress (kN/m2)
1	60	108
2	128	122
3	208	144
4	280	158
5	340	168

Table 5 : Value of thickness and void ratio with pressure

Pressure (kPa)	Thickness of sample after consolidation (mm)	Void ratio, e
0	20	0.73
50	19.8	0.71
100	19.6	0.69
200	19.4	0.65
400	19.2	0.63
800	19.1	0.62