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POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

CIVIL ENGINEERING DEPARTMENT

FINAL EXAMINATION

JUNE 2012 SESSION

CC304 : GEOTECHNICS 1

DATE : 20 NOVEMBER 2012

DURATION : 2 HOURS (8.30 AM – 10.30 AM)

This paper consists of **EIGHT (8)** pages including the front page.
Section A: Short Question (10 questions – answer all)
Section B: Essay Question (4 questions – answer 3 questions)

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(The CLO stated is for reference only)

SECTION A

SHORT QUESTION (40 marks)

INSTRUCTION:

This section consists of **TEN (10)** structured questions. Answer **ALL** the questions.

QUESTION 1

Provide **TWO (2)** types of soil and rock [CLO 1 : C2] (4 marks)

- igneous
- sedimentary
- organic soil / top soil
- residual soil

QUESTION 2

Undisturbed soil was taken from a construction site in Melaka. The collected data are as follows.

Volume of soil	= 1.756 x 10^{-3} m^3
Mass of tube	= 1.868 kg
Mass of tube and soil sample	= 5.021 kg
Mass of tube and dry soil sample	= 4.323 kg

Calculate:

a) Dry Density

b) Moisture content [CLO 1 : C3]

$W = \frac{M_T}{V_T}$

$\frac{5.021}{1.756 \times 10^{-3}} = 0.029$ (4 marks)

QUESTION 3

Define the following terms : [CLO1 :C1]

a) Liquid limit (LL)

b) Plastic limit (PL)

(4 marks)

QUESTION 4

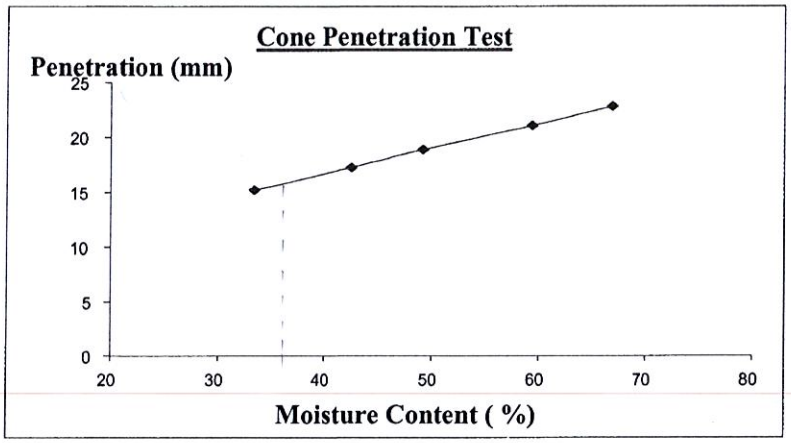


Figure A(4)

Based on Figure A(4), calculate the value of Plasticity Index (PI) if the plastic limit is 33%.[CLO1 :C2]

(4 marks)

QUESTION 5

State **TWO (2)** differences between Standard Proctor Compaction Test and Modified Proctor Compaction Test. [CLO 1: C2]

(4 marks)

QUESTION 6

a) The difference between total stress and pore water pressure is called effective stress. Define pore water pressure. [CLO1:C1]

(2 marks)

b) List **TWO (2)** factors that affect soil stress. [CLO1:C1]

(2 marks)

QUESTION 7

List down **FOUR (4)** important problems in soil engineering in relation to shear strength. [CLO1:C1]

(4 marks)

QUESTION 8

Sketch the Coulomb graph for**:** :[CLO1:C3]

(a) Cohesionless soil

(b) Cohesive soil

(4 marks)

QUESTION 9

Identify **TWO (2)** tests for permeability in laboratory. [CLO1:C1]

(4 marks)

QUESTION 10

Explain about consolidation concept using spring analogy process.[CLO1:C2]

(4 marks)

SECTION B

ESSAY (60 marks)

INSTRUCTION:

This section consists of **FOUR (4)** essay questions.

Answer **THREE (3)** questions only.

QUESTION 1

a) Rock can be divided into three types. State and explain the three types of rock.[CLO1:C2]

(9 marks)

b) Determine void ratio, porosity and degree of saturation of a soil sample with the given data below.[CLO1:C3]

Masses of soil sample, M_T = 1013g

Vol. of soil sample, V_T = 585.0cm^3

Specific Gravity, G_s = 2.65

Moisture Content, m = 12.1%

(11 marks)

QUESTION 2

a) Explain the following types of soil [CLO1:C2]

i) Top soil

ii) Residual soil

iii) Transported soil

(9 marks)

b) The mass of 0.0196 m^3 of a soil sample is 35.6kg. After the soil is oven dried for 24 hrs, the mass of the soil is 31.2 kg. The specific gravity of the soil is 2.71. Determine the following: [CLO1:C3]

i) Bulk density

ii) Dry density

iii) Moisture content

iv) Void ratio

v) Degree of saturation

(11 marks)

QUESTION 3

a) When a standard compaction test was performed on samples of heavy clay at four different moisture contents, the following dry densities were obtained:

Table B (3)

Sample number	1	2	3	4
Water content (%)	30	32.4	34.5	36
Dry density (kg/m^3)	1670	1690	1680	1660

To obtain another point on the dry density versus water content curve, another sample was subjected to the same compactive effort and the following data were obtained:

Mass of mould + compacted wet soil = 8256 g

Mass of mould = 5980 g

Capacity of mould = 1000 cm^3

Mass of sample taken from mould = 246 g

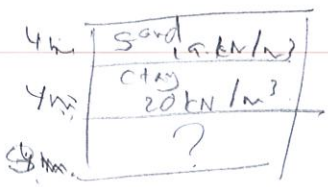
Mass of sample after thorough drying = 185 g

Make use of the above-mentioned information to determine the maximum dry density and the optimum water content.[CLO1:C3]

(12 marks)

b) A layer of saturated clay 4 m thick is overlain by sand 4 m thick. Water table being 3 m below ground surface. The saturated unit weight of the sand is 19 kN/m^3 and of the clay is 20 kN/m^3, the unit weight of sand above ground water table is 17 kN/m^3.Determine effective stress in depth 8m from surface of earth.

(8 marks)



QUESTION 4

a) The process of consolidation leads to a decrease in the void ratio and increase in the effective stress. Define consolidation in geotechnics term.[CLO1:C1]

(2 marks)

b) An undrained shear box test was carried out on sandy clay and yielded the following results. Determine the apparent cohesion, c and angle of friction for the soil, Φ.

[CLO1:C3]

Table B (4)

Sample	A	B	C
Normal stress (kN/m^2)	200	300	400
Shear stress at failure (kN/m^2)	113	141	167

(9 marks)

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c) During a test using falling head permeameter the following data were recorded. Determine the coefficient of permeability, k of the soil.[CLO1:C3]

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

(9 marks)

CC304 – GEOTECHNICS 1

1. $V_t = V_s + V_v = V_s + V_w + V_a$
2. $G_s = \frac{m_s}{V_s \rho_w}$
3. $\rho_d = \frac{\rho b}{1+w}$
4. $\rho_b = \frac{Ms(1+w)}{v}$
5. $\rho_b = \frac{Gs\rho w(1+w)}{1+e}$
6. $\rho_d = \frac{Gs\rho w}{1+e}$
7. $S = \frac{wGs}{e}$
8. $\rho_{sat} = \frac{\rho w(Gs+e)}{1+e}$
9. $\rho_d = \frac{G_s \rho_w (1-A_r)}{(1+\omega G_s)}$
10. $n = \frac{e}{1+e}$
11. $k = 2.303 \frac{aL}{At} \log_{10}(\frac{h_1}{h_2})$ atau $k = \frac{aL}{At} \ln(\frac{h_1}{h_2})$
12. $k = \frac{2.3039\, q\, log_{10}(\frac{r_2}{r_1})}{\pi(h_2^2 - h_1^2)}$ atau $k = \frac{q\, ln(\frac{r_2}{r_1})}{\pi(h_2^2 - h_1^2)}$
13. $k = \frac{q\, log_{10}(\frac{r_2}{r_1})}{2.727\, H\, (h_2 - h_1)}$ atau $k = \frac{q\, ln(\frac{r_2}{r_1})}{2\pi\, H\, (h_2 - h_1)}$
14. $K_H = \frac{1}{H}(K_1H_1 + K_2H_2 + ... + K_nH_n)$
15. $K_v = \frac{H}{\frac{H_1}{K_1} + \frac{H_2}{K_2} + \cdots ..... + \frac{H_n}{K_n}}$
16. $\sigma = \rho gh = \gamma h$
17. $\sigma = \sigma' + u$
18. $u = \gamma_w h$
19. $T_v = \frac{C_v\, t}{d^2}$
20. $C_v = \frac{0.848 d^2}{t_{90}}$
21. $C_v = \frac{k}{\gamma_w M_v}$

Perihalan			Simbol Kump.	Nama Tipikal	Kritiria Pengelasan Tanah Berbutiran Kasar	
Tanah berbutiran kasar (Ayak No. 200 > 50 % tertahan)	Kerikil (Ayak No. 4 > 50% tertahan)	Kerikil bersih	GW	Kerikil gred baik, campuran kerikil-pasir, sedikit atau tiada yang halus.	$Cu = D_{60} / D_{10} > 4$ $1 < Cc = D^2_{30} / (D_{10}D_{60}) < 3$	
			GP	Kerikil gred tak baik, campuran kerikil-pasir, sedikit atau tiada yang halus.	Tidak memenuhi keperluan GW	
		Kerikeril dengan material halus.	GM	Kerikil bertanah kolodak, campuran kelodak kerikil-pasir.	Had Atterberg di bawah garisan A atau PI < 4	Di atas garisan A dengan 4<PI<7 adalah kes sempadan, perlu menggunakan kedua-dua simbol.
			GC	Kerikil bertanah liat, campuran tanah liat kerikil-pasir.	Had Atterberg di atas garisan A atau PI > 7	
	Pasir (Ayak No. 4 > 50% telus	Pasir bersih	SW	Pasir gred baik, pasir berkerikil, sedikit atau tiada yang halus.	$Cu = D_{60} / D_{10} > 6$ $1 < Cc = D^2_{30} / (D_{10}D_{60}) < 3$	
			SP	Pasir gred tak baik, pasir berkerikil, sedikit atau tiada yang halus.	Tidak memenuhi keperluan SW	
		Pasir dengan material halus.	SM	Pasir bertanah kolodak, campuran pasir-kelodak.	Had Atterberg di bawah garisan A atau PI < 4	Had plotan dalam zon rapat dengan 4<PI<7 adalah kes sempadan, perlu menggunakan kedua-dua simbol.
			SC	Pasir bertanah liat, campuran pasir- tanah liat.	Had Atterberg di atas garisan A atau PI > 7	
Tanah berbutiran halus (Ayak No. 200 > 50% telus)	Kelodak dan tanah liat (LL < 50%)		ML	Kelodak tanpa organik dan pasir yang amat halus, habuk batuan, pasir halus bertanah kelodak atau bertanah liat atau kelodak bertanah liat dengan sedikit keplastikan.	1. Tentukan peratus pasir dan kerikil dari graf lengkung saiz butiran. 2. Bergantung kepada peratus butiran halus (lebih kecil dari ayak No. 200), tanah berbutiran kasar dikelaskan seperti berikut.- < 5% : GW, GP, SW, SP > 12% : GM, GC, SM, SC 5 – 12 % : kes sempadan, perlu menggunakan kedua-dua simbol.	
			CL	Tanah liat tanpa organik mempunyai keplastikan rendah atau sederhana, tanah liat berkerikil, tanah liat berpasir, tanah liat sahaja		
			OL	Kelodak organik dan tanah liat organik bertanah kelodak mempunyai keplastikan randah.		
	Kelodak dan tanah liat (LL > 50%)		MH	Kelodak tanpa organik, miseous atau diatomaseous halus berpasir atau tanah berkelodak, kelodak elastik.		
			CH	Tanah liat tanpa organik mempunyai keplastikan tinggi, tanah liat subur.		
			OH	Tanah liat organik mempunyai keplastikan sederhana hingga tinggi, kelodak organik.		
	Tanah organik tinggi		Pt	Tanah gambut dan lain-lain tanah dengan organik tinggi.		

Nota
GW - Well grade graval
GP - Poorly graded gravel
GM - Silty gravel
GC - Clayey gravel
SW - Well grade sand
SP - Poorly graded sand
SM - Silty sand
SC - Clayey sand
ML - Silt with low plasticity
CL - Clay with low plasticity
OL - Organic with low plasticity
MH - Silt with high plasticity
CH - Clay with high plasticity
OH - Organic with high plasticity
Pt - Peat

Jadual Sistem Pengelasan Tanah Bersekutu

CARTA KEPLASTIKAN

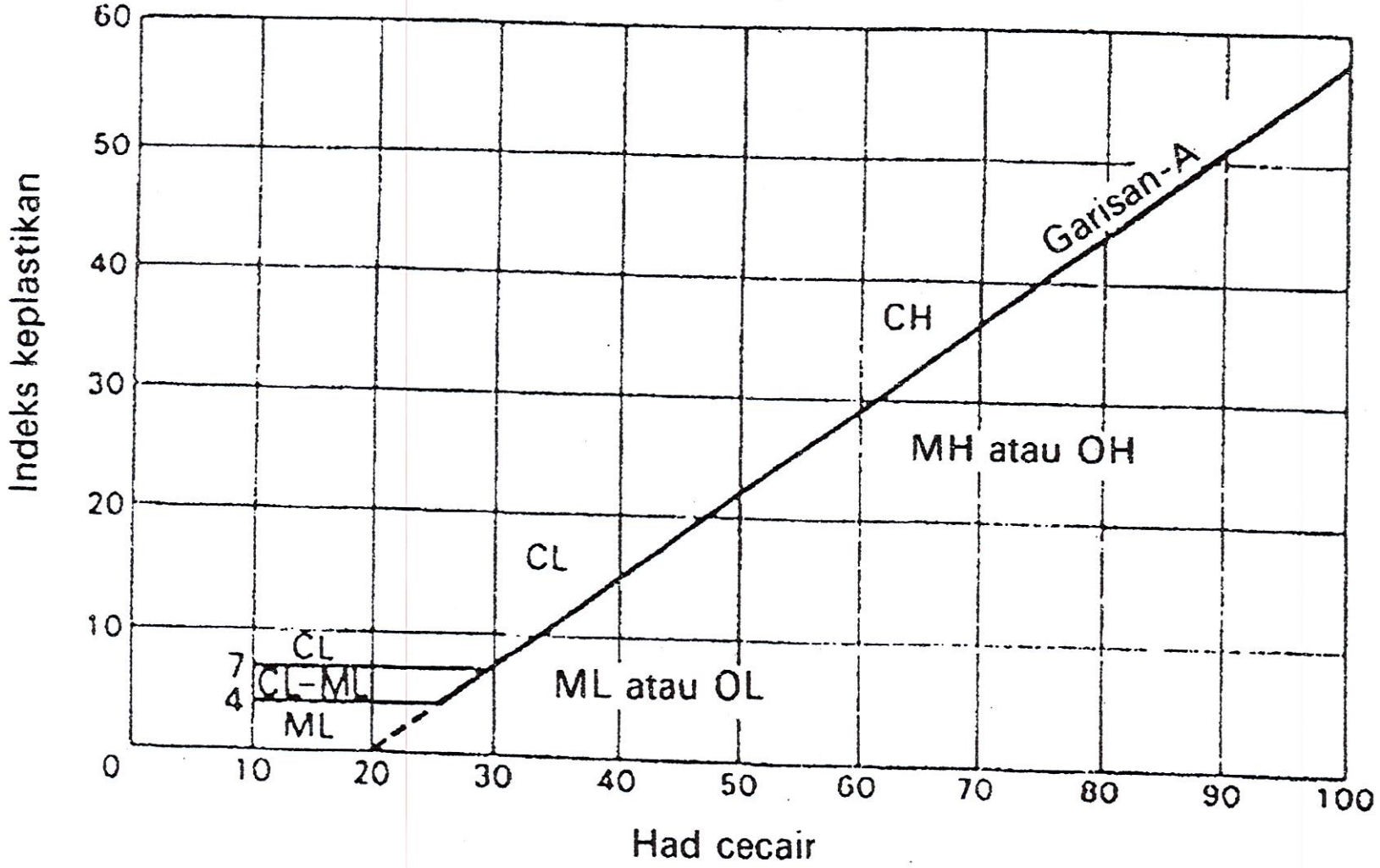
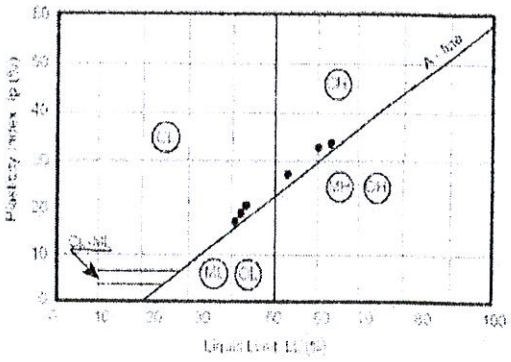


Table for Unified Soil Classification (USCS)

Field Identification Procedure			Group Symbols	Typical Names	Laboratory Classification Criteria	
Course-Graned Soils (More than half materials is larger than No. 200 - 0.075mm sieve size)	Gravel (More than half is larger than No. 4 – 4.75 mm sieve size)	Clean Gravel	GW	Well Graded gravels, gravels-sand mixures, little or no fines.	$Cu = D_{60} / D_{10} > 4$ $1 < Cc = D^2_{30} / (D_{10}D_{60}) < 3$	
			GP	Poorly Graded gravels, gravels-sand mixures, little or no fines.	Not meeting soil gradation requirements for GW	
		Gravel with Fines	GM	Silty Gravel, poorly graded gravel-sand, silt mixtures	Atterberg Limit below A line or PI < 4	Above A line with 4<PI<7 are borderline cases, requiring use of dual symbol
			GC	Clayey gravels. poorly graded gravel-sand, clay mixture	Atterberg Limit above A line or PI > 7	
	Sand (More than half is smaller than No. 4 -4.75mm sieve size)	Clean Sand	SW	Well Graded sands, gravelly-sand, little or no fines.	$Cu = D_{60} / D_{10} > 6$ $1 < Cc = D^2_{30} / (D_{10}D_{60}) < 3$	
			SP	Poorly Graded sand, gravelly-sand, little or no fines.	Not meeting soil gradation requirements for SW	
		Sand with Fines	SM	Silty sand, poorly graded sand-silt mixtures	Atterberg Limit below A line or PI < 4	Above A line with 4<PI<7 are borderline cases, requiring use of dual symbol
			SC	Clayey sand, poorly graded sand-clay mixture.	Atterberg Limit above A line or PI > 7	
Fine-Graned Soils (More than half materials is smaller than No. 200 – 0.075mm sieves size)	Silts and clays (LL < 50%)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity	1. Determine per percentages of gravel and sand from grain curve 2. Depending on percentage of fines fraction smaller than No 200 sieve size, coarse grained soils are classified as follow:- < 5% : GW, GP, SW, SP > 12% : GM, GC, SM, SC 5 – 12 % : borderline cases, requiring use of dual symbol	
			CL	Inorganic clays of low to medium plasticity, gravelly sands, sandy clays, silty clays, clean clays		
			OL	Organic silts and organic silty clay with low plasticity.		
	Silts and clays (LL > 50%)		MH	Inorganic silt , miseous or diatomaseous fine sandy or siltysoils, elastic silt		
			CH	Inorganic clays of high organic plasticity		
			OH	Organic clays of medium to high plasticity		
	Highly organic Soils		Pt	Peat and other organics soils		