UNIVERSITY OF JOHANNESBURG

PROGRAM	: DEGREE	
	: CONSTRUCTION MANAGEMENT & QUANTITY SURVEYING	
SUBJECT	: **SOIL MECHANICS 2A**	
CODE	: **SMECIA2**	
DATE	: WINTER EXAMINATION 2018 28 MAY 2018	
DURATION	: (Y-PAPER) 8:30 – 11:30	
WEIGHT	: 40 : 60	
FULL MARKS	: 70	
TOTAL MARKS	: 70	

EXAMINER	: MR M SHUPING	
MODERATOR	: MR F THAIMO	2251A
NUMBER OF PAGES	: 3 PAGES AND 1 ANNEXURES	

INSTRUCTIONS

ANSWER ALL QUESTIONS.
NON-PROGRAMMABLE SCIENTIFIC CALCULATORS MAY BE USED.
THE USE OF ALPHA-NUMERIC CALCULATORS IS PROHIBITED.

REQOUREMENTS

GRAPH PAPER

QUESTION 1

Name three (3) types of Pedogenic soil and their cementing agents.

[6]

QUESTION 2

The dry density of the soil can be expressed in terms of its particle relative density, void ratio and density of water. Working from basic definitions, derive an equation to illustrate this relationship.

(18)

Give an equation indicating the relationship between dry density, bulk density and water content.

(1)

[19]

QUESTION 3

A soil sample has dry and wet masses of 1200 kg and 1350 kg, respectively. The solid particles occupy a volume of 0,4 m^3 and the sample has a void ratio of 0,5. Working from first principles, determine the soil's

(i) Moisture content
(ii) Bulk density
(iii) Dry density
(iv) Porosity
(v) Degree of saturation
(vi) Air voids ratio
(vii) Moisture content when the soil is 90% saturated

[20]

QUESTION 4

The results of particle size analyses of the soil are shown in a table below. Using the chart in Annexure A, classify this soil according to the Unified Soil Classification System (USCS)

	Sieve Size (mm)	Percentage Passing
D_{10} = 0,06 mm	4,75	25
D_{30} = 5,0 mm	2,0	19
D_{60} = 19,0 mm	0.075	13
Liquid Limit = 25		
Plastic Limit = 12		

[5]

QUESTION 5

The following were obtained from a standard compaction test on a soil to establish its maximum dry density and optimum moisture content:

	Sample 1	Sample2	Sample3	Sample 3	Sample 4
Mass (g)	2010	2092	2114	2100	2055
Water Content (%)	12.8	14,5	15,6	16,8	19,2

The volume of the mould is 1000 cm^3 and the value of Gs is 2,67.

5.1 Determine the maximum dry density (kg/m^3) and optimum moisture content by plotting the moisture-density curve on the graph paper provided. (7)

5.2 Calculate the air voids content at the maximum dry density and optimum moisture content. (3)

[10]

QUESTION 6

6.1 Name two (2) testing methods commonly used in the field in order to assess the compacted layer's compliance with the project specification. (2)

6.2 List four (4) methods by which energy or compactive effort may be applied to a soil layer. (4)

6.3 List four (4) advantages of the Dynamic Cone Penetration (DCP) test apparatus. (4)

[10]

ANNEXURE A

Unified classification system

Major divisions			Group symbol	Typical names	Classification criteria for coarse-grained soils	
Coarse-grained soils (more than half of material is larger than No. 200) (0,075mm)	Gravels (more than half of coarse fraction is larger than No. 4 sieve size) 4,75mm	Clean gravels (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_U = D_{60}/D_{10} > 4$ $C_C = 1 < D^2_{30}/D_{10} \times D_{60} < 3$	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW	
		Gravels with fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A line or $I_p < 4$	Above A line with $4 < I_p < 7$ are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p > 7$	
	Sands (more than half of coarse fraction is smaller than No. 4 sieve size) 4,75mm	Clean sands (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_U = D_{60}/D_{10} > 6$ $C_C = 1 < D^2_{30}/D_{10} \times D_{60} < 3$	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW	
		Sands with fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A line or $I_p < 4$	Limits plotting in hatched zone with $4 \leq I_p \leq 7$ are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p > 7$	
Fine-grained soils (more than half of material is smaller than No. 200) (0,075mm)	Silts and clays (liquid limit < 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	1. Determine percentages of sand and gravel from grain-size curve. 2. Depending on percentages of fines (fraction smaller than 200 sieve size), coarse-grained soils are classified as follows: Less than 5%—GW, GP, SW, SP, More than 12%—GM, GC, SM, SC 5 to 12%—Borderline cases requiring dual symbols	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (liquid limit > 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts