PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: CIVIL*
SUBJECT	:	**SOIL MECHANICS 2A**
CODE	:	**CEGA211**
DATE	:	WINTER SSA EXAMINATION 2019 JULY 2019
DURATION	:	(X-PAPER) 08:00 – 10:00
WEIGHT	:	40 :60
FULL MARKS	:	70
TOTAL MARKS	:	70

EXAMINER	:	PROF GC FANOURAKIS
MODERATOR	:	MR F THAIMO
NUMBER OF PAGES	:	4 PAGES AND 2 ANNEXURES

INSTRUCTIONS

ANSWER ALL THE QUESTIONS.

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

QUESTION 1

Describe (in detail) collapsible soils and list possible options that may be implemented to found on these soils.

[8]

QUESTION 2

An undisturbed soil sample was taken from one of the compacted layers of a road pavement and sent for laboratory testing.

In the laboratory, the mass of the soil was recorded as 700 g. Thereafter, it was coated with wax and the combined mass of wax and soil was found to be 720 g. The volume of the wax-coated sample was determined, by displacement, as 400 ml.

The sample was then broken open and its moisture content and particle specific gravity (G) were determined as 18 % and 2.7, respectively. The specific gravity of the wax was 0,9. **Working from first principles**, determine the soil's:

Bulk density
Dry density
Void ratio
Degree of saturation

[13]

QUESTION 3

A saturated soil has a moisture content of 22 % and a dry density of 1400 kg/m^3. Determine its:

Void ratio
Specific gravity
Porosity
Saturated density

[9]

QUESTION 4

The following results were recorded in three liquid limit tests.

Number of taps (N)	16	23	35
Moisture Content (%)	22	19	13

4.1 Determine the liquid limit of the soil. (5)

4.2 If the plasticity limit of this soil is 10, determine the plasticity index. (2)

4.3 If the *in-situ* moisture content of the soil is 3 %, determine the liquidity index. Also, state how this soil is expected to behave at that *in-situ* moisture content. (4)

[11]

QUESTION 5

Using the chart provided as Annexure B, classify the following two (2) soils according to the Unified Soil Classification System (USCS).

Soil	**Percentage Passing Sieve Size (mm)**		**Liquid Limit**	**Plastic Limit**
	4,75 mm	**0,075 mm**		
A	20	25	29	16
B	99	70	45	20

[8]

QUESTION 6

When describing a soil according to the MCCSSO System, what is the relevance of describing the **Moisture, Consistency and Structure**?

[10]

QUESTION 7

7.1 A laboratory compaction test requires 794 KJ/m3 of energy to be imparted to a soil. The mould to be used has a diameter of 152 mm and a height of 125 mm. A hammer with a mass of 2,495 kg, which falls through a distance of 304,8 mm, is to be used.

Determine the number of layers and number of blows per layer required to impart this energy to the soil. (7)

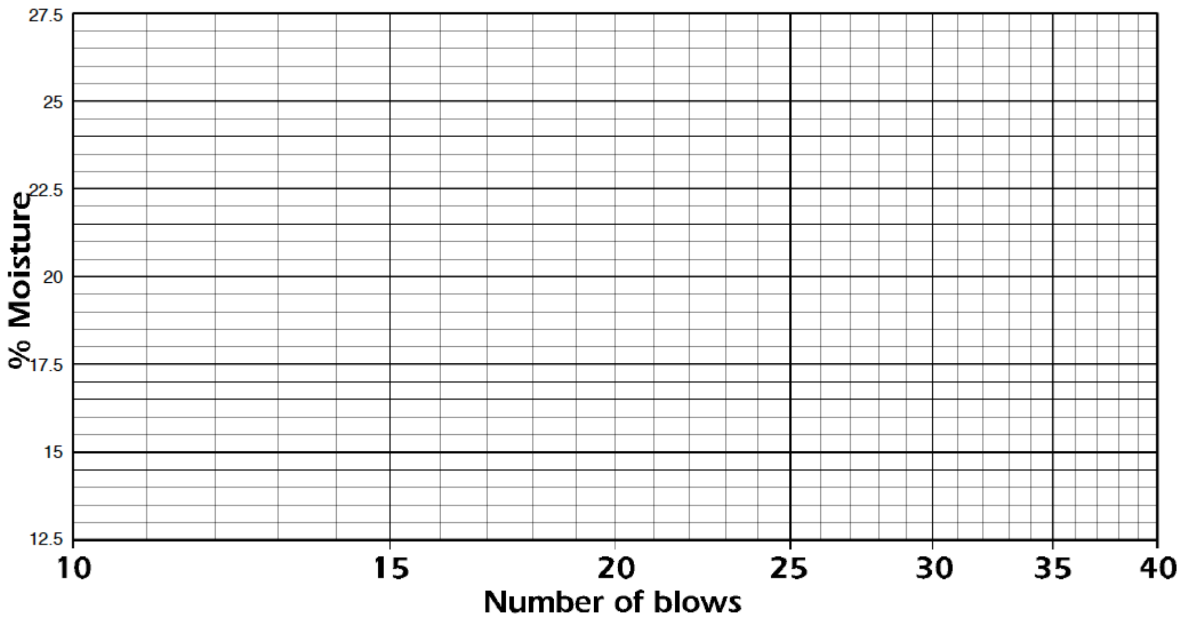
7.2 The results of a number of CBR tests conducted on a soil are given below. Using these results, determine the design CBR of this material, in accordance with the Asphalt Institute Manual MS-1 Method.

CBR: 12, 19, 19, 17, 18, 21, 21, 23, 25, 18. (4)

[11]

TOTAL : 70

ANNEXURE A


27.5
25
22.5
20
17.5
15
12.5
% Moisture
10
15
20
25
30
35
40
Number of blows

ANNEXURE B

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 course 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