TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)

ECE 2303: SOIL MECHANICS I

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Pocket Calculator*

This paper consists of **FIVE** questions. Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
Use neat, large and well labeled diagrams where required
This paper consists of **FOUR** printed pages

Question One (Compulsory)

A standard compaction test was carried out in a 105mm diameter mould of volume 0.001m^3 and mass 1125g. Results were:

Moisture content (%)	10	11	12	13	14
Mass of wet soil and mould (g)	3168	3300	3334	3350	3320

a) Plot the curve of dry density against moisture content and determine the value of maximum dry density and optimum moisture content.

b) On your graph plot the zero and 5% air voids lines (Gs =2.65)

c) At maximum dry density, determine:
   (i) Percentage air voids content
   (ii) Void ratio

(iii) Porosity

(iv) Degree of saturation

$$\rho_d = \frac{G_s(1-A_r)}{1+wG_s} \quad P_w$$

Dry density **(30 marks)**

Question Two

a) From basic principles derive the expression as applied in soil density calculations:

$$b = \left\{ \frac{G_s + eSr}{1+e} \right\} \quad w$$

Where γ_b = bulk unit weight Gs = specific gravity of soil grains, e = void ratio γ_w = unit weight of water **(10 marks)**

b) A soil sample in its natural state has a mass of 2.29kg and a volume of 1.15 x $10^{-3}m^3$ under an oven dried state, the dry mass of the sample is 2.035kg. The specific gravity of the solids is 2.68. Determine:

(i) The bulk density
(ii) Water content
(iii) Void ratio
(iv) Porosity
(v) The degree of saturation
(vi) Air voids ratio **(20marks)**

Question Three

a) Determine the plasticity index of soil from the following test data:

Liquid limit test:

Number of blows	49	31	18	11
Mass of moisture (g)	6.52	6.06	6.75	6.60
Mass of dry soil (g)	18.15	16.12	17.23	16.13

Plastic limit test

Test number	1	2
Mass of moisture (g)	1.38	1.32
Mass of dry soil (g)	6.37	6.37

b) The result of a sieve analysis test were:

Sieve Size (mm)	**Mass Retained (g)**
50	0
37.5	15.5

20	17
14	10
10	11
6.3	33
3.35	114.5
1.18	63.3
0.6	18.2
0.15	17
0.063	10.5

The total mass of the sample was 311g. Plot the particle size distribution curve and determine:

(i) Effective size of the soil

(ii) Uniformly coefficient of the soil

(iii) Coefficient of gradation **(20 marks)**

Question Four

a) An undistributed sample was taken from a borehole made in a stratum of a soil and was subjected to a falling head permeability test. Results were:
Diameter of the sample – 100mm
Length of the sample – 100mm
Initial head – 450mm
Final head – 380mm
Standpipe diameter – 3mm
Time interval – 4min

Calculate the coefficient of permeability in m/day **(10 marks)**

b) A field test to determine the coefficient of permeability was carried out. Results were:

Pumping out rate from central well – 8.5m^3/day
Water table, height above bedrock, during pumping

(i) At observation well (15m from the central casing) – 4.5m

(ii) At observation well (30m from the central casing) – 5.5m

If the soil stratum was unconfined, calculate the coefficient of permeability (m/day)

(20 marks)

Question Five

a) Figure 5.1 shows a layout of soil strata.

Figure 5.1

Clay: Saturated unit weight = 19KN/m^3
Sand: Dry unit weight = 17KN/m^3
Saturated unit weight γ_{sat}= 20KN/m^3

Draw graphs showing the variation with depth, of total vertical stress, pore pressure and effective vertical stress **(20 marks)**