TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2303: SOIL MECHANICS I

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

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

This paper consists of **FIVE** questions. Answer question **ONE (Compulsory)** and any **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Outline negative construction effects cause by clay minerals **(5 marks)**

b) Derive from first principle the expression used to determine dry density (y_d) of a soil based on bulk density (y_b) and moisture content (w) **(4 marks)**

c) A saturated soil sample was tested in a laboratory. The saturated density and moisture content were 2.045 mg/m3 and 23% respectively. Use a soil model to determine:
   (i) Dry density
   (ii) Void ratio

(iii) Particle specific gravity
(iv) Porosity **(11 marks)**

Question Two

a) Explain the following terms as applied to soil classification:
   (i) Coefficient of uniformity
   (ii) Plasticity index **(4 marks)**

b) Outline main aspects of the British soil classification system **(6 marks)**

c) Grading curve for an organic soil from a construction site is as shown in figure 1.
   (i) Use the curve to describe the soil
   (ii) Predict group symbol for the soil
   (iii) Plastic limit for the soil was tested and foe dot be 25% while test results for liquid limit were as follows:

Test number	1	2	3
Mass of empty tin	24.04	24.75	23.30
Mass of tin + wet soil (g)	45.04	49.21	48.28
Mass of tin + dry soil (g)	39.16	42.00	40.88
Number of blows	34	17	12

   Use figure 2 provided to determine the liquid limit.
   (iv) Using results obtained in (i), (ii), (iii) and figure 3 provided, classify the organic soil. **(10 marks)**

Question Three

a) Explain the following terms as applied to soil compaction:
   (i) Zero air voids dry density
   (ii) Optimum moisture content **(4 marks)**

b) State FOUR limitations that apply to standard compaction methods **(4 marks)**

c) A standard compaction test was carried out on clay soil of specific gravity 2.55. The results obtained were as follows:

Moisture content (%)	20	18.2	16.8	25.1	14.5	12.5
Bulk density (Kg/m^3)	2184	2160	2155	2140	2125	2058

Draw a compaction graph and use it to determine:
(i) Compaction parameters
(ii) Air voids ratio considering parameters obtained in c(i) **(12 marks)**

Question Four

a) State aims of compacting soils in a laboratory **(4 marks)**

b) Explain the disadvantages of changing from a lighter compaction effort to a heavier compaction effort. **(6 marks)**

c) **(i)** Illustrate typical graphical results for soil compaction of a coarse grained soil and a fine grained soil on same axes.

(ii) Explain the graphical presentation in (c) (i) **(5 marks)**

d) (i) Briefly explain the effect of clay minerals on permeability of coarse soils
(ii) A test soil sample was prepared by filling three soil types A, B, C in a cylindrical tube 8cm a diameter. The length and coefficient of permeability for the soils are as follows:

Soil type	Length (cm)	Coefficient of Permeability (m/s)
A	15.2	9.8×10^{-3}
B	10.0	2.2×10^{-5}
C	8.0	4.3×10^{-4}

Determine the average coefficient of permeability for the test sample if water was allowed to flow in the following directions:

- Vertical
- Horizontal **(5 marks)**

Question Five

a) A fine grained soil was tested in a falling head permeability apparatus in two stages. The following results were obtained during state 1 of the test:

Radius of standpipe used (mm)	6
Cross-sectional area of test specimen (mm^2)	2800
Length of the sample (mm)	50
Initial water level in stand pipe (mm)	1000
Final water level in stand pipe (mm)	600
Time taken for the water level to decrease	2 min 58 sec

(i) Determine coefficient of permeability for the soil
(ii) In stage 2, the soil sample was reduced to one half of its original length. Another soil of permeability 8.0×10^{-3}mm/s was added and the experiment repeated. Determine the expected permeability for combined layers considering a vertical flow direction. **(4 marks)**

b) (i) With the aid of a sketch, explain the term "flownet" as applied to determination of seepage under water retaining structures.
(ii) State conditions for application of flow nets
(iii) Illustrate the conditions in b(ii) on a sketch **(8 marks)**

c) Use figure 4 provided to determine:
(i) Rate of seepage under the sheet pile

(ii) "Quick sand" conditions if particle specific gravity and void ratio of the soil are 2.66 and 0.6 respectively. Take K = 4.56×10^{-4} m/s