TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
(BSCE 12J/13J/12M)

ECE 2303: SOIL MECHANICS I

END OF SEMESTER EXAMINATION
SERIES: APRIL 2014
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 other **TWO** questions
All questions carry equal marks
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One(Compulsory)

a) Briefly discuss the formation of soil. **(4 marks)**

b) Distinguish between single (granular) structure and flocculant structure in soils. **(4 marks)**

c) Discuss the FOUR field identification tests that are used to distinguish silt from clay **(8 marks)**

d) Outline the factors that affect permeability of soils. **(6 marks)**

e) A fully saturated clay sample has a volume of 185cm3 and weighs 331g. If the Gs of soil is 2.67. Determine:

(i) Void ratio
(ii) Water content (wc)
(iii) Porosity
(iv) Unit weight **(4 marks)**

f) A saturated sample of undisturbed clay has a volume of 19.2cm3 and weighs 32.5gm. After oven drying, the weight reduces to 20.2gm. Determine:
(i) Water content
(ii) Specific gravity **(4 marks)**

Question Two

a) A soil sample in its natural state has a mass of 2.29kg and a volume of 1.15×10^{-3}m3. Under oven dried state, the dry mass of the sample is 2.035kg. The specific gravity of the solids is 2.68. Determine
i) Total density
ii) Water content
iii) Void ratio
iv) Porosity
v) Degree of saturation **(5 marks)**

b) A sample of dry soil of mass 500g was used for sieve analysis. The masses of soil retained on each sieve are as given below:

Sieve Aperture (mm)	Mass in (g)
2.00mm	10
1.40mm	18
1.00mm	60
0.500mm	135
0.250mm	145
0.125mm	56
0.075mm	45

Plot a grain distribution curve and compute the following: **(4 marks)**

i) Percentages of gravel, coarse sand, medium and sand fire sand and silt as per the scale **(5 marks)**
ii) Uniformity of coefficient **(2 marks)**
iii) Coefficient of curvature **(2 marks)**

c) Define coefficient of uniformity CU **(2 marks)**

Question Three

a) (i) State Stoke's Law **(2 marks)**

(ii) Explain the Assumptions considered in applying Stoke's Law **(6 marks)**

b) Particles of FIVE different sizes are mixed in proportion as shown below and enough water added to make $1000cm^3$ of inspension. The temperature of the suspension is 20^oC

Particle Size (mm)	Weight (g)
0.050	6
0.020	20
0.10	15
0.005	5
0.001	4
Total	50g

Take Gs = 2.70, unit weight of water = 1g/cm3

$$\mu = 1.11 \times 10^{-5}\, g.s/cm^2$$

Viscosity of water

i) What is the largest particle size present at a depth of 8cm, 10 minutes after start of sedimentation? **(3 marks)**

ii) What is Gs of suspension at a depth of 8cm, 10 minutes after sedimentation? **(5 marks)**

iii) How long should sedimentation be allowed until all the particles have settled below 8cm? **(4 marks)**

Question Four

a) Define soil compaction. **(2 marks)**

b) Outline the factors affecting soil compaction **(3 marks)**

c) A sand sample of 35cm^2 cross-sectional area and 20cm long was tested in a constant head permeameter. Under a head of 60cm, the discharge was 120ml in 6min. The dry weight of sand used for the test was 1120g and G – 2.68. Determine:
   (i) Coefficient of permeability in cm/sec
   (ii) The discharge velocity
   (iii) The seepage velocity **(6 marks)**

Question Five

a) Briefly discuss the assumptions considered when computing stresses using Boussinesq's formula. **(4 marks)**

b) Three parallel strip footings 3m wide each and 5m apart centre to centre transmit contact pressures of 200, 150 and 100KN/m^2 respectively. Calculate the vertical stress due to the combined loads beneath the centres of each footing at a depth for 3m below the base. Assume the footings are placed at a depth of 2m below the ground surface. Use Bousinesq's equation for line loads. **(6 marks)**

c) Briefly describe the critical hydraulic gradient and its application in piping in soils and design of filters. **(10 marks)**