



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)  
*Faculty of Engineering and Technology*

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING  
**DIPLOMA IN BUILDING & CIVIL ENGINEERING (DBC 10B)**  
**DIPLOMA IN CIVIL ENGINEERING (DC 10B)**  
**DIPLOMA IN ARCHITECTURE (DA 10B)**

EBC 2216: SOIL MECHANICS  
SPECIAL/SUPPLEMENTARY EXAMINATION  
SERIES: FEBRUARY/MARCH 2012

**TIME: 2 HOURS**

## **Instructions to Candidates:**

You should have the following for this examination

- *Answer Booklet*
- *Scientific Calculator*
- *2 No. Graph Papers*
- *Grading Chart*
- *Casagrande Chart*
- *Plasticity Chart*

This paper consists of **FIVE** questions

Answer question **ONE (COMPULSORY)** from **SECTION A** and any other **TWO** questions from **SECTION B**  
Maximum marks for each part of a question are clearly shown

This paper consists of **FOUR** printed pages

**SECTION A (COMPULSORY)**

**Question 1**

- a) (i) With the aid of a sketch, describe the falling head determination of coefficient of permeability for a fine-grained soil  
(ii) From basic principles, derive the equation for determining the coefficient of permeability of the soil for (i) above (8 marks)
- b) A clay soil has a bulk unit weight of  $19.4\text{KN/m}^3$  and a moisture content of 24.3%. If the specific gravity of the soil particles is 2.75, determine:  
(i) Dry unit weight  
(ii) Void ratio  
(iii) Degree of saturation  
(iv) The saturated unit weight assuming that the void ratio remains constant (12 marks)
- c) Define the following terms as applied to shear strength:  
(i) Principal plane  
(ii) Principal stress (2 marks)
- d) In a series of unconsolidated-undrained tests on specimens of fully saturated clay, the following results were obtained at failure. Determine the values of shear strength parameters. (8 marks)

<b>All round pressure (KN/m<sup>2</sup>)</b>	200	400	600
<b>Principal stress difference (KN/m<sup>3</sup>)</b>	222	218	220

Use graph paper provided.

**SECTION B (Answer any TWO questions from this section)**

**Question 2**

- a) (i) Briefly describe the standard compaction test.  
(ii) The following results were obtained from a compaction test

<b>Moisture content (%)</b>	13	14	15	16
<b>Bulk density (Kg/m<sup>3</sup>)</b>	2043	2100	2110	2117

Use the data provided to:

- Plot the compaction curve on a graph paper
  - Determine the compaction parameter (14 marks)
- b) Outline **TWO** factors affecting compaction (6 marks)

### Question 3

- a) The results obtained when an organic soil of plastic limit 27% was tested using casagrande apparatus were as shown in table below

Test no	1	2	3
Moisture content (%)	50.65	50.38	50.12
No. of Blows	12	18	27

- (i) Determine the liquid limit (use figure 1)  
(ii) Using results obtained in (i) and figure 2, classify the soil (6 marks)
- b) The results obtained from a sieve analysis on a soil sample are given in table below. If the total mass of the sample was 311g, plot the particle size distribution curve on Chart 1. From the curve, determine:  
(i) The effective size and uniformity coefficient  
(ii) Describe the soil and give the group symbol of classification (14 marks)

Sieve size (mm)	Mass retained (g)
50	0
37.5	15.5
20	17.0
14	10.0
10	11.0
6.3	33.0
3.35	114.5
1.18	63.3
0.60	18.2
0.15	17.0
0.063	10.5

### Question 4

- a) Define the following terms as applied in soil mechanics:  
(i) Degree of saturation  
(ii) Bulk unit weight  
(iii) Porosity (4½ marks)
- b) A sample of soil weighing 30.6kg had a volume of 0.0183m<sup>3</sup>. When dried an oven its weight reduced to 27.2 kg. If the specific gravity of the soil solids was 2.65, determine the following:  
(i) Bulk density  
(ii) Dry density  
(iii) Percentage moisture content  
(iv) Percentage air voids  
(v) Void ratio  
(vi) Porosity  
(vii) Critical hydraulic gradient (15½ marks)

### Question 5

- a) State **FIVE** factors upon which properties of soils are derived. (7½ marks)
- b) A variable head was made on a soil sample of length 350mm. The water level in a 30mm diameter standpipe fell from 1650mm to 1100mm after 60seconds. Determine the coefficient of permeability of the soil if the diameter of the sample was 80mm (7½ marks)
- c) A sample had a cohesion of  $15\text{KN/m}^2$ , internal angle of friction  $21^\circ$  and normal stress of  $30\text{KN/m}^2$ . Calculate the shear stress using Coulomb's equation. (5 marks)