



## TECHNICAL UNIVERSITY OF MOMBASA

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SCHOOL OF ENGINEERING AND TECHNOLOGY  
Department of BUILDING & Civil engineering  
**UNIVERSITY EXAMINATION FOR:**

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING  
**TCV 4414: GEOTECHNICAL ENGINEERING**  
END OF SEMESTER EXAMINATION  
**SERIES: JANUARY 2025**  
**TIME: 2 HOURS**

### **Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of **five** questions.

Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

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### **QUESTION ONE (COMPULSORY)**

#### **Question One (Compulsory)**

**(20marks)**

- a) Discuss soil phases. **(6marks)**
- b) Briefly describe three in-situ field tests commonly used in sub-surface soil investigations. **(6marks)**
- c) A soil sample in its natural state has a mass of 2.29kg and a volume of  $1.15 \times 10^{-3} \text{m}^3$ . Under an oven dried state, the dry mass of the sample is 2.035kg. The specific gravity of the solids is 2.68. Determine the following;-
  - i) Bulk density
  - ii) Water content
  - iii) Void ratio.
  - iv) Porosity
  - v) Degree of saturation

**(8marks)**

#### **Question Two**

**(20marks)**

- a) A sample of saturated clay has a mass of 1.526 kg. and a dry mass of 1.053kg. The specific gravity of the solid particles is 2.7. For the sample, determine;
- i) Water content
  - ii) Void ratio
  - iii) Porosity
  - iv) Total density. **(8marks)**
- b) Outline the objectives of in-situ field testing. **(4marks)**
- c) Discuss soil settlement and causes. **(8marks)**

### Question Three

**(20 Marks)**

a) An under-reamed bored pile is to be installed in stiff clay. The diameters of the pile shaft and under-reamer base are 1.05m and 3.0m respectively. The pile is to extend from a depth of 4m to a depth of 22m in the clay, the top of the under-reamer being at a depth of 20m. At the base level, the un-drained strength is  $240\text{kN/m}^2$  and average value of un-drained strength between depths 4m and 18m is  $150\text{kN/m}^2$ . The bearing capacity factor  $N_c$  is 9.0 and the adhesion coefficient  $\alpha$  is 0.4. Determine;

- i) The Ultimate load carrying capacity of the pile.
  - ii) Allowable load when allowing for a factor of safety of 2 and 3 for side friction and base resistance respectively. **(8marks)**
- b) Briefly describe the effects of the following on response of rock to imposed loads;
- i) Rock fracture ii) Size effects iii) Effect of ground water. **(6marks)**
- c) Outline the main objectives of ground investigation. **(6marks)**

### Question Four

**(20marks)**

- a) Using illustrations, describe Underpinning. **(10marks)**
- b) Explain the following geo-mechanical properties and discontinuities;
- i) Spacing ii) Persistence iii) Aperture iv) Filling v) Rock Quality Designation (RQD) **(8marks)**
  - ii) Define geotechnical engineering. **(2marks)**

### Question Five

**(20marks)**

- a) Using illustrations, explain the following geotechnical structural terms;
- i) Bedding planes **(2marks)**
  - ii) Faults **(2marks)**
  - iii) Folds **(2marks)**
  - iv) Joints **(2marks)**
  - v) Dykes **(2marks)**
- b) Discuss **four (4)** types of Geosynthetics. Including their functions. **(10marks)**