



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
UNIVERSITY EXAMINATIONS FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
TCV 4414: GEOTECHNICAL ENGINEERING
END OF SEMESTER EXAMINATION
SERIES: APRIL 2025
TIME: 2 HOURS (PB)

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.

QUESTION ONE (COMPULSORY)

Question One (Compulsory)

(20marks)

- a) Explain the main objectives of **Ground Investigation**. **(6marks)**
- b) Discuss soil phases. **(6marks)**
- c) 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)**

Question Two

(20marks)

- a) Discuss “Frost Action” in soils and how it can be mitigated. **(8marks)**
- b) 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)
- c) Explain the objectives of in-situ field testing. (4marks)

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 240kN/m^2 and average value of un-drained strength between depths 4m and 18m is 150kN/m^2 . The bearing capacity factor N_c is 9.0 and the adhesion coefficient α 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) Briefly describe three in-situ field tests commonly used in sub-surface soil investigations. (6marks)

Question Four

(20marks)

- a) Using illustrations, describe the Shoring Process. (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)