TECHNICAL UNIVERSITY OF MOMBASA

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

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
SCHOOL BASED PROGRAMME
TCV 4414: GEOTECHNICAL ENGINEERING
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: JULY 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 soil settlement. **(8marks)**

b) A soil sample in its natural state has a mass of 2.29kg and a volume of $1.15x10^{-3}m^3$. 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)**