TECHNICAL UNIVERSITY OF MOMBASA

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.

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 $1.15x10^{-3}m^3$. 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)

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 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) 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)**