(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS

2021/2022 ACADEMIC YEAR

2ND YEAR SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF BUILDING TECHNOLOGY IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: BTB 222

COURSE TITLE: SOIL MECHANICS II

DATE: 2ND AUGUST 2022 **TIME: 11 A.M – 1 P.M**

2 HOURS

INSTRUCTIONS:

1. This paper consists of **FOUR** questions.
2. **ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS.**
3. Marks for each question are indicated in the parenthesis.

MMUST observes ZERO tolerance to examination cheating

Question ONE (30 Marks)

a) Define the following terms as used in soil mechanics:
   i. Shear strength of soil
   ii. Cohesion
   iii. Principal plane
   iv. Principal stress. **[4 Marks]**

b) With the aid of diagrams/ sketches, describe the following types of slope failures. **[6 Marks]**
   I. Rotational slope failure -
   II. Translational slope failure -

c) What is site investigation? State THREE objectives of site investigation. **[4 Marks]**

d) What do you understand by the term desk study? State and explain FOUR sources of information for desk study. **[6 Marks]**

e) On a failure plane in a purely frictional mass of dry sand, the total stresses at failure were found to be: shear stress = $4.5KN/m^2$ and normal stress = $12KN/m^2$. Determine:
   i. The resultant complex stress on the plane of failure
   ii. The angle of shearing resistance of the soil
   iii. The major and minor principal stresses, σ_1 and σ_3
   iv. The angle of inclination of the failure plane to the major principal plane.

[10 Marks]

Question TWO (20 marks)

a) State the differences between finite and infinite slopes. **[2 Marks]**

b) Describe how the following processes causes slope failures:
   Seepage
   Freezing and thawing
   Excavation. **[3 Marks]**

c) Outline the **THREE** general assumptions employed in the slope stability analysis. **[3 Marks]**

d) A granular soil located in Koromatangi area within Kakamega county was found to have a saturated unit weight of $18KN/m^3$ and an angle of shearing resistance of 30° C. If a slope is to be made of this material, determine the safe angle of the slope:
   i. When the slope is dry or submerged
   ii. If seepage occurs at and parallel to the surface of the slope.

   Assume the factor of safety as 1.5. **[5 Marks]**

Question FOUR (20 Marks)

a) What is a retaining wall? **[1 Marks]**

b) Using diagrams briefly **describe** the following types of retaining walls. **[6 Marks]**

i. Gravity walls

ii. Cantilever walls

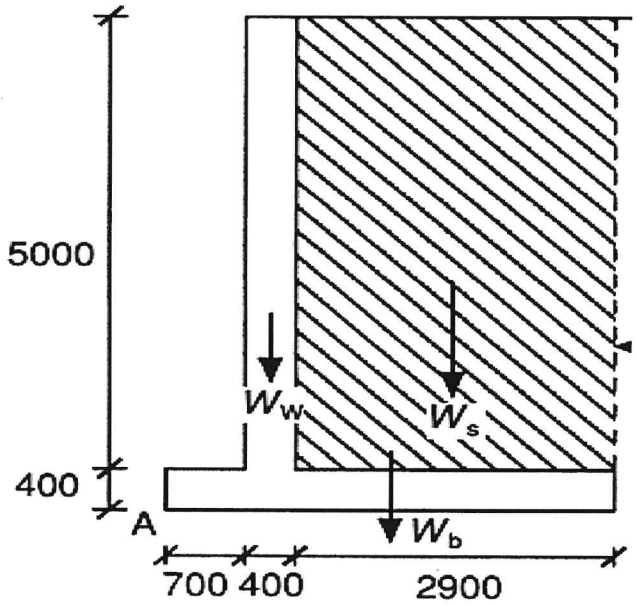
iii. Counterfort walls

c) The cantilever retaining wall shown below is backfilled with granular material having a unit weight, ρ, of 19 kNm^{-3} and an internal angle of friction, ø, of 30°. Assuming that the allowable bearing pressure of the soil is 120 kNm^{-2}, the coefficient of friction is 0.4 and the unit weight of reinforced concrete is 24 kNm^{-3}.

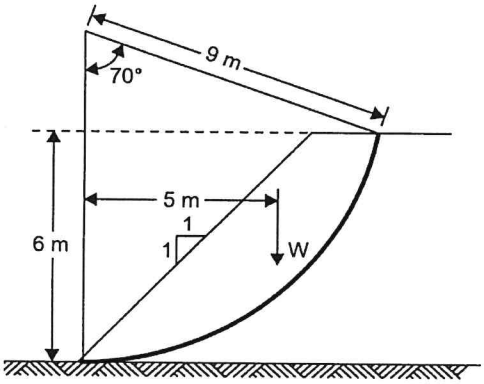
i. Determine the factor of safety against sliding

ii. Determine the factor of safety against overturning

iii. Calculate the ground bearing pressure. **[13 Marks]**



The figure below shows the details of an embankment made of cohesive soil with φ = 0 and c = 30 KN/m2. The unit weight of the soil is 18.9 KN/m3. Determine the factor of safety against sliding along the trial circle shown. The weight of the sliding mass is 360 KN acting at an eccentricity of 5.0 m from the centre of rotation. Assume that no tension crack develops. The central angle is 70. **[7 Marks]**



Question THREE (20 marks)

a) Outline FOUR assumptions in Rankine's Theory of lateral earth pressure. **[4 Marks]**

b) Differentiate between active and passive earth pressure. Use sketches for your illustrations. **[6 Marks]**

c) A cantilever retaining wall of 7-meter height shown below retains sand. The properties of the sand are: e = 0.5, ø = 30° and G_s = 2.7. Using Rankine's theory determine the active earth pressure at the base when the backfill is (i) dry, (ii) saturated and (iii) submerged, and also the resultant active force in each case. In addition, determine the total water pressure under the submerged condition. **[10 Marks]**