(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

2ND YEAR SEMESTER TWO MAIN EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: BTB 222

COURSE TITLE: SOIL MECHANICS II

DATE: WEDNESDAY 20TH APRIL 2022 TIME: 12:00 – 2:00 PM

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.
4. **The examination is 2 hours**.

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

Question ONE (30 Marks)

a) Define the following terms as used in soil mechanics.   [3 Marks]
   i.   Shear strength of soil
   ii. Principal plane
   iii. Normal stress
b) Outline **TWO** sources from which soil derives its shear strength.   [1 Marks]
c) Outline the **THREE** general assumptions employed in the slope stability analysis. [3 Marks]
d) State Mohr – Coulomb theory.   [2 Marks]
e) On a failure plane in a purely frictional mass of dry sand, the total stresses at failure were:
   shear = 3.5 kN/m2; normal stress = 10 kN/m2. Determine.   [10 Marks]
   i.   The resultant stress on the failure plane
   ii.   The angle of shearing resistance of the soil
   iii. The angle of inclination of the failure plane to the major principal plane
   iv.   The major and minor principal stresses, σ_1 and σ_3.
f) What do you understand by the term desk study? Briefly highlight **FOUR** aims/ benefits of Desk study.   [5 Marks]

g) The following results were obtained from a series of drained triaxial tests performed on soil samples collected from TVET & Engineering Complex site. Each test was continued until failure and the effective principal stresses tabled below. Plot the relevant Mohr stress circles and hence determine the strength envelope of the soil with respect to effective stress.   [6 Marks]

Test No.	σ'_3 (kN/m^2)	σ'_1 (kN/m^2)
1	200	570
2	300	875
3	400	1162

Question TWO (20 marks)

a) What is slope. State the differences between man-made and natural slopes, giving two examples in each case.   [3 Marks]
b) Explain how the following conditions enhances the slope failures.   [5 Marks]
   i.   Erosion
   ii.   Earthquakes
   iii. Sudden drawdown
   iv.   Surcharge
   v.   Construction activities at the toe of the slope.
c) With the aid of well-labelled diagrams, describe THREE types of slope failures.   [6 Marks]

d) Civil engineering activities such as road/dam constructions require special attention to the stability of slopes. Engineers ensure the stability of slopes on the embarkments of such structures by analyzing the slope conditions and providing certain factor of safety to the analysis. Briefly explain what this factor of safety is. **[2 Marks]**

    i. A 5m deep canal has a side slope of 1:1. The properties of the saturated soil were C_u = 25 kN/m², n = 0.36, G_s = 2.67 and Taylor's stability number = 0.118. Determine the factor of safety with respect to cohesion of the embarkment. **[4 Marks]**

Question THREE (20 marks)

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

b) Outline **THREE** factors that influence the design requirements for the estimation of lateral earth pressure on an earth retaining structure. **[3 Marks]**

c) Explain the following terms as used in lateral earth pressure. **[3 Marks]**

    i. Pressure at rest

    ii. Active earth pressure

    iii. Passive earth pressure.

d) A counterfort wall of 10m height retains a non-cohesive backfill. The **porosity** and **angle of internal friction** of the backfill respectively are **0.412** and **30°** in the loose state and they are **0.286** and **40°** in the dense state. Calculate and compare active and passive earth pressures for both cases and comment on the effects of densification of soils. Take the specific gravity of solids as 2.7. **[10 Marks]**

Question FOUR (20 Marks)

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

b) Using sketches briefly **describe** the following types of retaining walls. **[3 Marks]**

    i. Gravity walls

    ii. Cantilever walls

    iii. Counterfort walls

c) Briefly describe **THREE** methods of failure of retaining walls that need to be considered during the design process. **[3 Marks]**

d) The cantilever retaining wall shown below is backfilled with granular material having a unit weight, ρ, of 18 kNm⁻³ and an internal angle of friction, ø, of 30°. Assuming that the coefficient of friction is 0.5 and the unit weight of reinforced concrete is 24 kNm⁻³. **[13 Marks]**

    i. Determine the factor of safety against sliding

        a) When no shear key is provided

        b) When shear key is provided

    ii. Determine the factor of safety against overturning.

600

2900

500

500

Backfill material

3200