MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 308: SOIL MECHANICS II

DATE: 14/12/2021 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

1. *This paper comprises of FIVE questions. Answer **THREE** questions*
2. *Question one is **compulsory** and carry 30 marks*
3. *Answer any other **TWO** questions*

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Define the following terminologies as applied to shear strength of soils (5 marks)

i. Complex stresses
ii. Principal plane
iii. Principal stress
iv. Major principal stress
v. Minor principal stress

b) From first principles derive the following equations: (10 marks)

i. Shear (or tangential) stress, $\boldsymbol{\tau = \frac{\sigma_1 - \sigma_3}{2} \mathrm{Sin} 2\theta}$

ii. Norman stress, $\boldsymbol{\sigma_n = \sigma_3 + (\sigma_1 - \sigma_3) \mathrm{Cos}^2 \theta}$

c) A series of undisturbed samples from normally consolidated clay was subjected to consolidated undrained tests. The results were: (15 marks)

Cell pressure (kNm^{-2})	Deviator stress at failure (kNm^{-2})	Pore water pressure ($kNm^{-2)}$
200	118	110
400	240	220
600	353	320

Plot in the same graph the strength envelop of the soil

i. With respect to total stress
ii. With respect to effective stress

QUESTION TWO (20 MARKS)

a) With the aid of sketches describe types of soil in terms of shear strength giving an example of each. (3 marks)

b) State the factors which affect shearing resistance of a soil (6 marks)

c) A cylindrical specimen of a saturated soil fails under an axial stress of $150kNm^{-2}$ in an unconfined compression test. The failure plane makes an angle of 52^o with the horizontal. Calculate the cohesion and angle of shearing resistance of the soil. (11 marks)

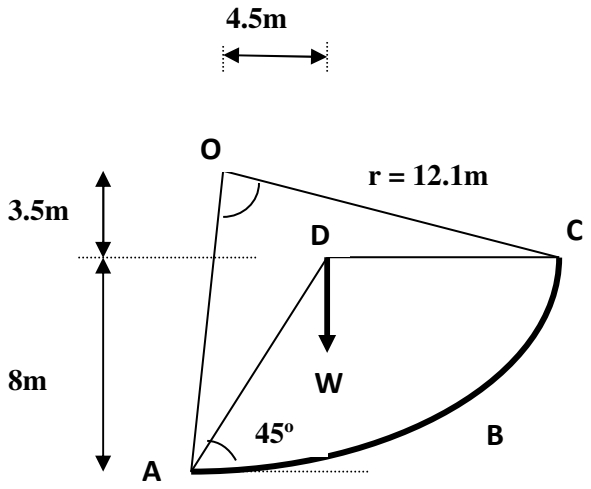
QUESTION THREE (20 MARKS)

a) Define the following terms as applied to stability of slopes (4 marks)

i) Infinite slopes
ii) Finite slopes

b) The figure below shows a 45^o slope ABCD of cross sectional area of $70m^2$ excavated to a depth of 8m in a deep layer of saturated clay of unit weight $19kNm^{-3}$. If the shear strength parameters, cohesion (C) and angle of internal friction (ϕ) are $65kNm^{-2}$ and 0^o respectively if the angle AOC is 89.5^o,

i. Determine the factor of safety for the trial failure surface
ii. Determine the minimum factor of safety if Ns = 0.18
iii. Check that no loss of overall stability will occur according to the limit state approach (16 marks)



QUESTION FOUR (20 MARKS)

a) What is soil stabilization? (2 marks)
b) Describe types of soil stabilization (4 marks)

c) What are the effects of lime and cement on soil properties? (4 marks)

d) If a cohesive soil and a non-cohesive soil are blended,

i. what type of stabilization is that,
ii. With the help of a shear strength envelope describe resulting soil. (10 marks)

QUESTION FIVE (20 MARKS)

a) With the aid of sketches, describe different types of slope failures. (8 marks)

b) An embankment 10m high is inclined at an angle of 36^o to the horizon. A stability analysis by the method of slices gives the sum of shearing forces, normal forces and neutral forces as 450kN, 900kN, and 216kN respectively. The length of the failure arc is 27m. If laboratory tests on the soil indicate the effective stress values C' and ϕ' as $20kNm^{-2}$ and 18^o respectively, determine the factor of safety with respect to shearing strength and cohesion. (12 marks)