MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

FIFTH YEAR SEMESTER ONE MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 521

COURSE TITLE: GEOTECHNICAL ENGINEERING

DATE: 6TH DECEMBER 2023 TIME: 3 P.M. – 5 P.M.

INSTRUCTIONS:

1. This paper contains FOUR questions
2. QUESTION ONE IS COMPULSORY
3. Attempt any other Two questions
4. Marks for each question are indicated in the parenthesis.
5. Graph Papers SHALL be provided.

Examination duration is **2 HourS**

MMUST observes ZERO tolerance to examination cheating

Question ONE (30 marks): COMPULSORY

a) Describe the formation process, the structure and the properties of the illite group of clay. **[6 marks]**

b) Distinguish between 'Black Cotton Soil' and Laterite soil from an engineering point of view. **[4 marks]**

c) List any five distinguishing features of expansive clays. **[5 marks]**

d) What is underpinning? Using neat diagrams, illustrate any three types of underpinning. **[10 marks]**

e) Highlight and explain any 5 factors that contribute to heaving in expansive soils. **[5 marks]**

Question TWO (20 marks)

a) **Figure Q2a** shows a drilled pier embedded in expansive soil. The details of the pier are given as; L_1= 5m, L_2 = 15m, d =0.6m cu= 120 kN/m^2,p_s = 500 kN/m^2

Determine:

i. The total uplift capacity. **[2 marks]**

ii. Total resisting force. **[4 marks]**

iii. Factor of safety with no load acting on the top pier **[2 marks]**

iv. Factor of safety with a dead load of 220kN on the top of the pier **[2 marks]**

Calculate Qup by Chen's Method.

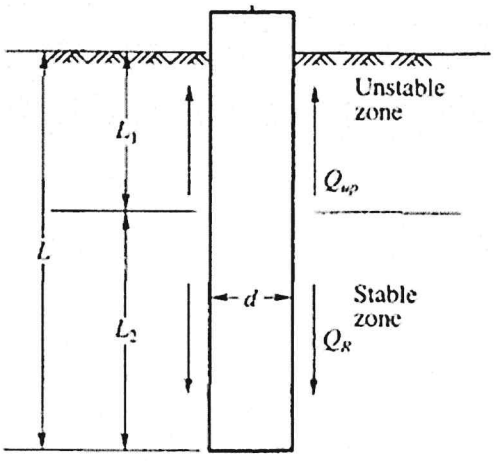

FIGURE Q2a

b) Discuss soil stabilization as applied in expansive clays. **[4 marks]**

c) You have been appointed as a design engineer for the construction of a building in Kakamega. Geotechnical investigation has revealed that the soils are expansive clays. What structural measures will you suggest for mitigating damages caused by the swelling characteristics of these types of soils? **[6 marks]**

Question THREE (20 marks)

a) Highlight any TWO signs of foundation failure. **[2 marks]**

b) Shoring is the process of temporarily supporting a structure at risk of collapse or while repairs or alterations are being made. Using neat diagrams and clear illustration, discuss the following types of shores.

i. Raking shores **[6 marks]**

ii. Flying shores **[6 marks]**

iii. Dead shores **[6 marks]**

Question FOUR (20 marks)

a) A footing of size **3 x 3 m** is founded at a depth of **2m** below ground level in collapsible soil of loessial type. The thickness of the stratum susceptible to collapse is 6m. The soil at the site is normally consolidated. In order to determine the collapse settlement, double oedometer tests conducted on two undisturbed soil samples (**Table Q4a).** The average unit weight of soil is 19 kN/m^3 and the induced stress ΔP at the middle of the stratum due to the foundation pressure is $48kN/m^2$. Estimate the collapse settlement of the footing under a soaked condition. **[12 marks]**

Table Q4a

Applied pressure kN/m^2	**10**	**20**	**40**	**100**	**200**	**400**	**800**
Void ratio at natural moisture content	0.79	0.78	0.77	0.74	0.70	0.64	0.53
Void ratio at soaked content	0.74	0.70	0.65	0.54	0.42	0.30	0.18

b) Explain any three causes of foundation failure. **[3 marks]**

c) Describe how laterite soils are formed in tropical regions and outline **THREE** differences between the laterite soils and red soils. **[5 marks]**