



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

**FIFTH YEAR SEMESTER ONE
SPECIAL AND SUPPLEMENTARY EXAMINATIONS**

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

COURSE CODE: CSE 521

COURSE TITLE: GEOTECHNICAL ENGINEERING

DATE: TUESDAY 26TH JANUARY 2021 TIME: 11.00 AM – 1.00 PM

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.

Examination duration is **2 Hour**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

Question ONE (30 marks)

a) Describe the following types of soils:

- i. Expansive Soil
- ii. Compressible soil
- iii. Collapsible soil

[6 marks]

b) What do you understand by underpinning? What are the necessary precautions which must be taken before carrying out this procedure?

[7 marks]

c) Explain SIX foundation considerations for expansive soils

[6 marks]

d) The following compression readings were obtained in an oedometer test on a specimen of saturated clay:

σ' (kN/m ²)	0	54	107	214	429	858	1716	3432	0
Dial Guage after 24 hrs, mm	5.00	4.747	4.49 3	4.108	3.44 9	2.608	1.676	0.737	1.480

The initial thickness of the specimen was 19.0 mm and at the end of the test the water content was 19.8% and the specific gravity was 2.73. Plot e-log σ curve and determine the coefficient of compressibility between 100-200 and 1000-1500 kN/m². What is the value of C_c for the latter increment?

[11 marks]

Question TWO (20 marks)

a) Describe the following underpinning methods

- i. Jack pile underpinning
- ii. Needle and pile underpinning
- iii. 'Pynford' Stool method of underpinning
- iv. Root pile or angle Piling

[10 marks]

b) Find the allowable capacity of the belled caisson shown in **Figure Q2b**. The diameter of the bottom of the bell is 4 m and the height of the bell is 2 m. Diameter of the shaft is 1.8 m and the height of the shaft is 10 m. Cohesion of the clay layer is 100 kN/m². Adhesion factor (a) was found to be 0.55. Ignore the skin friction in the bell and one diameter of the shaft above

the bell (Assume any missing data)

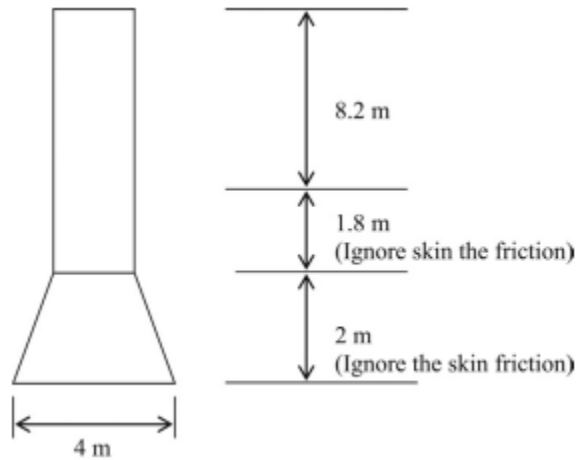


Figure Q2b

[10 marks]

Question THREE (20 marks)

- a) Describe the FOUR main groups of clays [10 marks]
- b) Describe the following soil stabilization operations for expansive soils
- i. Pre-wetting or flooding the in-situ soil to achieve swelling prior to construction.
 - ii. Compaction control
 - iii. Soil replacement
 - iv. Chemical stabilization [10 marks]

Question FOUR (20 marks)

- a) A concrete pile is 20 m length and 360 mm x 360 mm in cross section. The pile is fully embedded in sand which unit weight is 16.8 kN/m³ and $\phi = 30^\circ$. You are given also $N_{q*} = 56.7$. Calculate:
- i. The ultimate load (Q_p), by using Meyerhof's method. [7 marks]
 - ii. Determine the frictional resistance (Q_s), if $k = 1.3$ and $\delta = 0.8\phi$. [5 marks]
 - iii. Estimate the allowable load carrying capacity of the pile (Use FS = 4). [4 marks]
- b) Outline the properties of red coffee soils and black cotton soils [4 marks]