



(University of Choice)

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

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER EXAMINATIONS

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

COURSE CODE: CSE 421

COURSE TITLE: FOUNDATION ENGINEERING

DATE: TUESDAY 19TH APRIL 2022 TIME: 12.00 – 2.00 PM

INSTRUCTIONS:

1. This paper consists of **FIVE** questions
2. Answer question **ONE** and **ANY** other **THREE** questions
3. All symbols have their usual meaning unless otherwise stated
4. Examination duration is 2 hours

MMUST observes **ZERO** tolerance to examination cheating

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

Question ONE {COMPULSORY (25 marks)}

- a) In soil sampling for analysis, differentiate disturbed and undisturbed soil samples (2 marks)
- b) Give 3 methods commonly used for subsurface exploration (2 marks)
- c) Give 2 applications of retaining walls (2 Marks)
- d) Define Earth Pressure and give factors that affect its action. (2 Marks)
- e) Give 3 (three) assumptions in the Terzaghi's analysis of soil bearing capacity (3 Marks)
- f) A 2.5m square footing is to be placed at distance of 2m below the surface of a saturated clay soil. The water table is located a distance of 1.0m below the ground surface. The Soil properties are as follows:
- saturated density = 1.9Mg/m³
 - undrained cohesion c_u = 110kN/m²
 - undrained friction angle ϕ_u = 0°
 - drained cohesion c_d = 15kN/m²
 - drained friction angle ϕ_d = 30°

Determine the allowable bearing capacity for short and long term conditions. (14 marks)

Question TWO (15 marks)

- a) Give an advantage on the use of geophysical methods in foundation investigation (1 marks)
- b) With respect to foundation settlement, explain the following considerations in foundation design
- i. Soil settlement (1 Marks)
 - ii. Soil Erosion (1 Marks)
 - iii. Water table fluctuations (1 Marks)
- c) With the help of a sketch, give an example of a shallow and a deep foundation (4 marks)
- d) A 2.5m square footing is to be placed at distance of 2m below the surface of a saturated clay soil. The water table is located a distance of 1.0m below the ground surface. Determine the allowable bearing capacity for short and long term conditions.
- i. Soil properties:
 - ii. saturated density = 1.9Mg/m³
 - iii. undrained cohesion c_u = 110kN/m²
 - iv. undrained friction angle ϕ_u = 0°
 - v. drained cohesion c_d = 15kN/m²
 - vi. drained friction angle ϕ_d = 35° (7 marks)

Question THREE (15 marks)

- a) Explain 3 (three) possible causes of foundation movement (3 marks)
- b) Explain 4 (four) environmental considerations in foundation design and construction (4 marks)
- c) Give 3 (three) assumptions in the Prandtl's analysis of soil bearing capacity (3 Marks)
- d) A column 400 mm×400 mm carries a dead load of 800 kN and an imposed load of 300 kN. The safe bearing pressure is 200 kN/m². Assume the weight of the base to be 80kN.

Determine the base dimensions. (5 marks)

Question FOUR (15 marks)

- a) Define ultimate soil bearing capacity (1 Marks)
- b) Give 3 classifications of pile foundations based construction materials (3 Marks)
- c) Give 3 advantages of use of piles in foundation construction (3 Marks)
- d) The characteristic loads for an internal column footing in a building are;

	<i>Vertical load (kN)</i>	<i>Horizontal load (kN)</i>	<i>Moment (kN m)</i>
Dead	770	35	78
Imposed	330	15	34

The proposed dimensions for the column and base are; Length 6.3m and Width 2.8m. The base supports a ground floor slab 200 mm thick. The soil is a firm well-drained clay with the following properties: Density 18 kN/m³, Safe bearing pressure 150 kN/m² and Cohesion 60 kN/m²

Determine the maximum pressure at the column base (8 marks)

Question FIVE (15 marks)

- a) Give 2 applications of retaining walls (2 Marks)
- b) With the aid of sketches, describe the source of stability for the following retaining walls;
- Gravity retaining wall (2 Marks)
 - T-shaped Cantilever retaining wall (2 Marks)
 - Counterfort retaining wall (2 Marks)
- c) A cantilever retaining wall is to be used to support a bank of earth 3.5 m high. The top surface is horizontal behind the wall but it is subjected to a dead load surcharge of 15 kN/m². The soil behind the wall is a well-drained sand with the following properties:

- Density of sand $\gamma=17.6 \text{ kN/m}^3$
- Angle of internal friction $\phi =30^\circ$
- The material under the wall has a safe bearing pressure of 100 kN/m^2
- The coefficient of friction between the base and the soil is 0.5
- The wall and base thickness are assumed to be 200 mm.

Check the stability of the wall against overturning, sliding and subsidence

(7 marks)

Terzaghi's Bearing Capacity Factors.

ϕ	N_c	N_q	N_γ
0	5.7	1	0
5	7.3	1.6	0.5
10	9.6	2.7	1.2
15	12.9	4.4	2.5
20	17.7	7.4	5
25	25.1	12.7	9.7
30	37.2	22.5	19.7
35	57.8	41.4	42.4
40	95.7	81.3	100.4
45	172.3	173.3	297.5
48	258.3	287.9	780.1