



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR**

FORTH YEAR FIRST SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL
ENGINEERING &
BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION**

COURSE CODE: CSE 421 / BTB 451

COURSE TITLE: FOUNDATION ENGINEERING

DATE: 6TH DECEMBER 2023

TIME: 8 A.M – 10 A.M

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

MMUST observes **ZERO** tolerance to examination cheating

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

Question ONE {COMPULSORY (25 marks)}

- a) Explain two soil conditions that may necessitate the use of mat foundations (4 Marks)
- b) Explain why a geophysical method would be preferred in a soil sampling exercise (2 Marks)
- c) Give two vital requirements of a foundation design (4 Marks)
- d) Differentiate Immediate Settlement and Consolidation Settlement of foundations (4Marks)
- e) Define the allowable bearing capacity of a soil (1 Marks)
- f) A rectangular foundation footing is required to carry loads from two columns $Q_1= 1200\text{kN}$ and $Q_2=800\text{kN}$. The horizontal distance between the two columns is 4 meters and the soil bearing capacity $q=180\text{kN/m}^2$. The property line requires that the two columns are located 1.5meters. Using an appropriate sketch, determine the dimensions of the footing. (10 Marks)

Question TWO (15 marks)

- a) Describe the major role of a foundation in a structure (2 Marks)
- b) Explain two advantages of pile foundations (4 Marks)
- c) Give two common assumptions of the Prandtl 1921/Reisner 1924 analysis of soil bearing pressure (2 Marks)
- d) A square column footing of dimensions 1.5 by 1.5m is to be placed at distance of 2m below the surface of a saturated clay soil. The water table is located a distance of 1.2m below the ground surface. The Soil properties are as follows:
- saturated density = 1.9Mg/m^3
 - undrained cohesion c_u = 120kN/m^2
 - undrained friction angle ϕ_u = 0°
 - drained cohesion c_d = 15kN/m^2
 - drained friction angle ϕ_d = 36°

Determine the allowable bearing capacity for the drained condition of the soil. (7 marks)

Question THREE (15 marks)

- a) When sampling, explain how uncertainties due to the random nature of soil can be minimized (2 Marks)
- b) In design of foundations, Give four conditions that may necessitate the use of deep foundations (4 Marks)
- c) Explain the importance of considering soil settlement and soil erosion when designing foundations (4 Marks)

- d) An internal square column 300 mm×300 mm carries a dead load of 1200 kN and an imposed load of 600 kN. The soil safe bearing pressure is 180 kN/m². Assume the weight of the base to be 100kN. Determine the base dimensions. (5Marks)

Question FOUR (15 marks)

- a) When carrying out soil sampling, explain how uncertainties due to model, transformation and measurement errors can be minimized (2 Marks)
- b) During design of foundations, give two factors that may guide the type of foundation to be adopted (4 Marks)
- c) Define the safe gross bearing capacity of a soil (1 Marks)
- e) A gravity retaining wall is to be used to support a bank of earth 2m high. The wall retains earth which is horizontal and not subjected to any surcharge. The soil behind the wall is a well-drained sand with the following properties:
- Density of sand $\gamma=20$ kN/m³
 - Angle of internal friction $\phi =35^\circ$
 - The material under the wall has a safe bearing pressure of 200 kN/m²
 - The coefficient of friction between the base and the soil is 0.5
 - The wall thickness is 600mm and base thickness is 900 mm.

Check the stability of the wall against overturning (8 marks)

Question FIVE (15 marks)

- a) Give two advantages of sheet piles as applied in civil engineering works (2 Marks)
- b) Give four assumptions of Terzagui's soil bearing capacity theory (4 Marks)
- c) Give 3 conditions that may necessitate the use of combined footings in foundation design (3 Marks)
- d) In planning for subsurface investigation, explain the importance of reconnaissance (2 Marks)
- e) With the aid of sketches, describe gravity and buttress retaining walls (4 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