



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 301: SOIL MECHANICS I

DATE:12/8/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS

- This paper comprises of five questions. Answer **three** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **two** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terminologies as applied to a 3-phase system in soil mechanics
- Porosity
 - Void ratio
 - Degree of saturation
 - Dry unit weight
 - Saturated unit weight (10 marks)
- b) From first principles and in terms of void ratio (e), degree of saturation (S_r), particle specific gravity (G_s), and unit weight of water (γ_w), derive the following expressions: (10 marks)
- Moisture content
 - Bulk unit weight
 - Dry unit weight
 - Saturated unit weight
 - Submerged unit weight

- c) A dry soil has a void ratio of 0.65 and a grain specific gravity of 2.8. Water is added to the sample so that its degree of saturation is 60% without any change in void ratio. The sample is next wholly immersed in water. Determine (10 marks)
- Bulk unit weight of the soil
 - Dry unit weight
 - Moisture content
 - Saturated unit weight if degree of saturation is 95%

QUESTION TWO (20 MARKS)

- a) State Stokes law and describe why it is important in soil particle size distribution (4 marks)
- b) The results of particle size analysis for a soil sample is shown below. Plot the gradation curve and determine D_{10} , D_{30} , D_{60} , C_u and C_z . (16 marks)

Sieve size	Particle size	Percentage smaller
63mm		100
20mm		76
6.3mm		65
2mm		59
600 μ m		54
212 μ m		47
63 μ m		34
	0.020mm	23
	0.006mm	14
	0.002mm	7

QUESTION THREE (20 MARKS)

- a) Define the following terms as applied to cohesive soils (5 marks)
- Consistency of a soil
 - Liquid limit
 - Plastic limit
 - Plasticity index
 - Linear shrinkage

- b) The Cone Penetrometer test results for a soil sample are shown in the table below. If the plastic limit is 24.1%, plot the graph and determine. (15 marks)
- The liquid limit
 - Plasticity index

Cone penetration (mm)	15.5	18.0	19.4	22.2	24.9
Moisture content (%)	39.3	40.8	42.1	44.6	45.6

QUESTION FOUR (20 MARKS)

- Define the following terms as applied to permeability of soil (3 marks)
 - A phreatic surface
 - A perched water table
- The coefficient of permeability may be determined in the laboratory by constant-head and falling-head methods. State the type of soil each method is suitable for. (3 marks)
- Derive from first principles an expression for the coefficient of permeability determined by the falling-head permeameter (10 marks)
- In a falling-head permeability test, the head causing flow was initially 50cm and dropped 2 cm in 5 minutes. How much time is required for the head to fall to 25cm? (4 marks)

QUESTION FIVE (20 MARKS)

- Define the following terms as applied to groundwater. (6 marks)
 - Seepage
 - Hydraulic gradient
 - A flow line
 - Equipotential line
- A deposit of cohesionless soil with a coefficient of permeability of $2 \times 10^{-2} \text{ cm/s}$ has a depth of 12m to an impervious layer. A sheet pile wall is driven into the deposit to a depth of 7.5m. The wall extends above the surface of the soil and a 4.5m depth of water acts on one side. Sketch the flow net and determine the seepage quantity per metre length of wall. (14 marks)