MACHAKOS UNIVERSITY

University Examination 2019/2020

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 301 SOIL MECHANICS I

DATE: 13/12/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) With illustrations, where possible, explain the importance of soils in the field of civil engineering (3 marks)

b) From first principles and with aid of a unit solid volume soil model, derive expressions for the listed variable as functions of void ratio, degree of saturation, particle specific gravity, and density of water (9 marks)

i. Air-void content

ii. Water content

iii. Saturated density

c) A soil specimen 38 mm in diameter and 76 mm long, and in its natural condition weighs 168.0 g. When dried completely in an oven, the specimen weighs 130.5 g. The value of particle specific gravity is 2.73. What is the degree of saturation of the specimen? (3 marks)

d) In a falling-head permeability test the initial head of 1.00 m dropped to 0.35 m in 3 hours, the diameter of the standpipe being 5 mm. The soil specimen was 200 mm long by 100 mm in diameter. Calculate the coefficient of permeability of the soil (3 marks)

e) With aid of sketches or equations, where necessary, differentiate the following pairs of terms as used in soil mechanics (6 marks)

i. Well graded soil and uniformly graded soil

ii. Plastic limit and shrinkage limit

iii. Vadose water and phreatic water

f) With aid of sketches and equations briefly explain the constant head permeability test for determining the hydraulic conductivity of a soil in the laboratory (6 marks)

QUESTION TWO (20 MARKS)

The results of particle size analyses and, where appropriate, limit tests on samples of four soils are given in Table Q2.

a) Plot the grading curves and describe the soils using appropriate qualifying terms (16 marks)

b) Allot group symbols (4 marks)

Table Q2

BS Sieve	Particle size	Percentage smaller			
		Soil A	Soil B	Soil C	Soil D
63 mm					
20 mm		100			
6.3 mm		94	100		
2 mm		69	98		
600 mm		32	88	100	
212 mm		13	67	95	100
63 mm		2	37	73	99
	0.020 mm		22	46	88
	0.006 mm		11	25	71
	0.002 mm		4	13	58
Liquid limit			Non-plastic	32	78
Plastic limit				24	31

QUESTION THREE (20 MARKS)

The results in Table Q3 were obtained from a standard compaction test on a soil:

Table Q3

Water content (%)	8	11.5	14.5	17.5	19.5	21.5
Mass of wet soil (kg)	1.70	1.90	2.00	1.98	1.95	1.92

If the volume of the mould used was 950 cm3, and the specific gravity of the soil was 2.65,

a) Draw the dry density vs moisture content curve (8 marks)

b) Determine the maximum dry density and optimum water content (2 marks)

c) Plot the 100% and 80% saturation lines (5 marks)

d) Estimate the degree of saturation at the optimum water content (1 mark)

e) Indicate on the graph, the range of dry density that may be expected from the field compaction, if the field air voids and optimum water content are allowed to vary by ± 2% (4 marks)

QUESTION FOUR (20 MARKS)

The cross-section of a homogeneous earth dam is shown in Figure Q4. The coefficient of permeability is 5.0 x 10^{-6} m/s. determine:

a) The phreatic line for the dam (10 marks)

b) The discharge passing through the dam (10 marks)

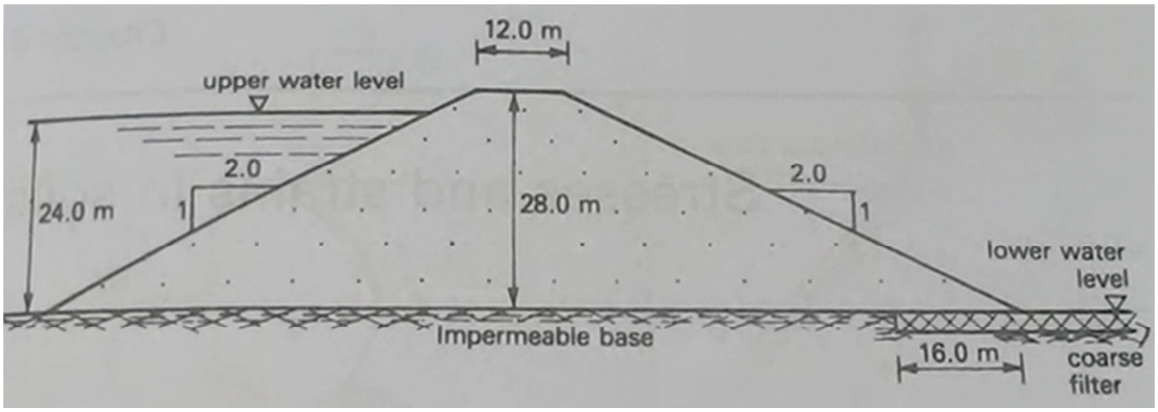

Figure Q4

QUESTION FIVE (20 MARKS)

An impervious paved area is to be constructed on a base of clayey silt during the wet season. Observations indicate that the water table will stabilize at 1.7 m below formation level. Using the data given in Table Q5, prepare an equilibrium water content profile and compare it with in situ water contents.

Data:

WL = 66%, Wp = 35%, average unit weight = 18.7 kN/m3.

Contact pressure at formation level = 7.5 kPa

Wetting curve (pF = 1.0 to 4.0): Equilibrium water content = 48 – 9.0 pF

Table Q5

Depth below formation (m)	0.1	0.5	1.5	2.5	4.0	5.0	6.0
In-situe water content before construction (%)	24.7	25.3	25.8	25.0	24.5	24.0	23.8