Ref. No. Ex/CE/5/T/302/2019

B.E. CIVIL ENGINEERING (PART TIME) THIRD YEAR FIRST SEMESTER EXAM – 2019

SOIL MECHANICS – I

Time: Three Hours

Full Marks 100
Part I: 50 Marks
Part II: 50 Marks

Use Separate Answer-Scripts for each Part

Question No.	Part I (50 Marks)	Marks
	*Answer **ANY TWO** questions from this Part. Assume reasonable values of data, if not supplied. MM graph papers will be provided, if required.*	
1.	a) What is Mohr-Coulomb failure theory for soils? Sketch a typical failure envelope for clean sand.	7
	b) Define slow, quick and consolidated quick triaxial shear tests, illustrating their use by at least one field example.	8
	c) The following results were obtained from a CU test on a normally consolidated soil: Cell Pressure (kN/m^2) 250 500 750 Deviator stress at failure (kN/m^2) 152 300 455 Pore water pressure at failure (kN/m^2) 120 250 350 Determine the effective stress strength parameters by plotting modified failure envelope.	10
2.	a) Define the terms (i) void ratio, (ii) porosity and develop a relationship between the two.	7
	b) A saturated sample of soil has a water content of 40%. If the specific gravity of grains is 2.67, determine voids ratio, saturated density and submerged density.	5
	c) A sample of soil of mass 40 gm is dispersed in 1000 ml of water. How long after the commencement of sedimentation should the hydrometer reading be taken in order to estimate the percentage of particles less than 0.002 mm effective diameter? Also find the corresponding N% finer. The centre of the bulb is at an effective depth of 20 cm below the water surface. Take G = 2.65, η = 0.01 poise, volume of hydrometer = 62 ml and area of cross-section of jar = 55 cm^2.	8
	d) A soil has liquid limit and plastic limit of 47% and 33% respectively. If the volumetric shrinkages at the liquid limit and the plastic limit are 44% and 29% respectively, determine the shrinkage limit.	5

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Question No.	Part I (50 Marks)	Marks
3.	a) A clay layer 3 m thick is overlain by a deposit of silty sand 6 m thick. The water table is located 3 m below the ground surface. The unit weight of the silty sand above and below the water table is 18.5 kN/m^3 and 20.5 kN/m^3 respectively. Also the unit weight of clay is 19.2 kN/m^3. Draw (i) the total stress, (ii) the pore water pressure, and (iii) the effective stress profile.	10
	b) In a falling head permeameter, the sample used is 20 cm long having a cross-sectional area of 24 cm^2. Calculate the time required for a drop of head from 25 to 12 cm if the cross sectional area of the stand pipe is 2 cm^2. The sample of soil is made of three layers. The thickness of the first layer from the top is 8 cm and has a value of $k_1 = 2 \times 10^{-4}$ cm/sec, the second layer of thickness 8 cm has $k_2 = 5 \times 10^{-4}$ cm/sec and the bottom layer of thickness 4 cm has and $k_3 = 7 \times 10^{-4}$ cm/sec. Assume that the flow is taking place perpendicular to the layers.	8
	c) How would you determine the average permeability of a stratified soil deposit consisting of 'n' number of layers with different coefficient of permeability values?	7

BACHELOR OF ENGINEERING (CIVIL ENGINEERING), 2019

(Third Year, First Semester)

SOIL MECHANICS-I

[PART-II]

Time: Three Hours

Full Marks 100
(50 marks for this part)

(Answer all the questions.)
[Assume any data reasonably if necessary]

1(a) The results of a standard Proctor test are given in the following table. Determine the maximum dry density (kg/m^3) of compaction and the optimum moisture content. **[6]**

Volume of Proctor mold (cm3)	Mass of wet soil in the mold (kg)	Moisture content (%)
944	1.68	9.9
944	1.71	10.6
944	1.77	12.1
944	1.83	13.8
944	1.86	15.1
944	1.88	17.4
944	1.87	19.4
944	1.85	21.2

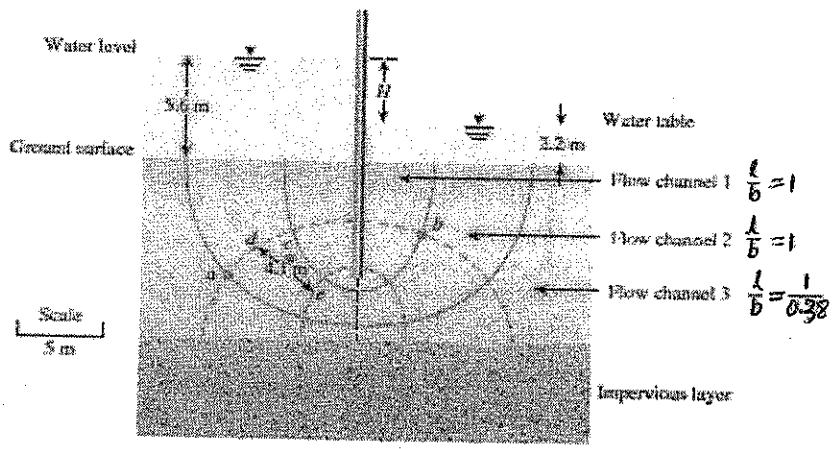
(b) A field unit weight determination test for the soil described in the previous problem yielded the following data: moisture content = 10.5% and moist density = 1705 kg/m^3. Determine the relative compaction. **[4]**

(c) Write a short note on 'Specification for Field Compaction'. **[5]**

2(a) Define flow line and equipotential line in seepage. Derive an expression for the calculation of seepage from a flow net. **[3+6]**

(b) A flow net for flow around a single row of sheet piles in a permeable soil layer is shown in Figure. Given that $k_x = k_z = k = 5 \times 10^{-3}$cm/sec, determine **[6]**

i. How high (above ground surface) the water will rise if piezometers are placed at points *a* and *b*.
ii. The total rate of seepage through the permeable layer per unit length
iii. The approximate average hydraulic gradient at *c*.



BACHELOR OF ENGINEERING (CIVIL ENGINEERING), 2019

(Third Year, First Semester)

SOIL MECHANICS-I

[PART-II]

Time: Three Hours

Full Marks 100
(50 marks for this part)

Question No.	(Answer all the questions.) [Assume any data reasonably if necessary]	Marks
3(a)	Following are the results of a laboratory consolidation test on a soil specimen obtained from the field: Dry mass of specimen = 128 g, height of specimen at the beginning of the test = 2.54 cm, G_s = 2.75 and area of the specimen = 30.68 cm^2.	[8]

Effective Pressure, σ' (kg/cm^2)	Final height of the specimen at the end of consolidation (cm)
0	2.54
0.5	2.49
1	2.46
2	2.43
4	2.39
8	2.32
16	2.22

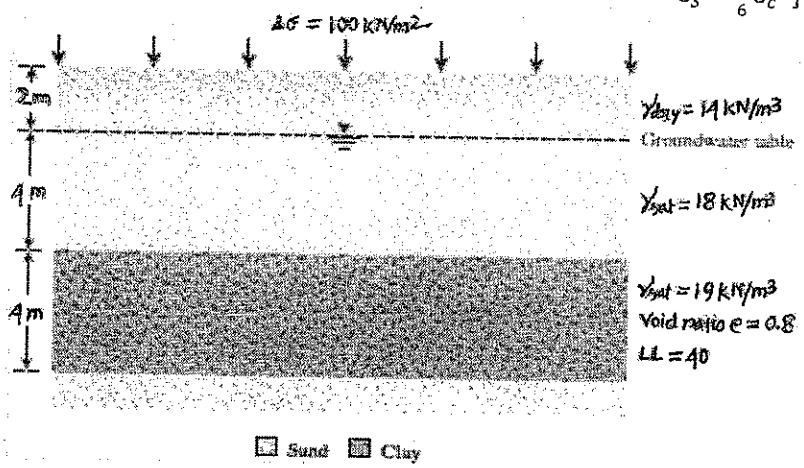
Draw e vs log σ' curve

OR

(a) A soil profile is shown in Figure below. If a uniformly distributed load, $\Delta\sigma$, is applied at the ground surface, what is the settlement of the clay layer caused by primary consolidation if

a. The clay is normally consolidated

b. The preconsolidation pressure (σ_c') = 190 kN/m^2 [Use, $C_c = 0.009(LL - 10)$ $C_S \approx \frac{1}{6}C_c$] [8]



(b) (i) Write down the boundary conditions required to solve Tezaghi's consolidation theory.
(ii) What are the parameters by which the solution of Terzaghi's consolidation theory is represented?
(iii) Define average degree of consolidation. [2+2+2]

(c) A 3-m-thick layer (double drainage) of saturated clay under a surcharge loading underwent 80% primary consolidation in 65 days. Find the coefficient of consolidation of clay for the pressure range. [6]