Ref. No. EX/CON/PC/B/T/223/2024

B. E. CONSTRUCTION ENGINEERING 2ND YEAR 2ND SEMESTER - 2024

SUBJECT: Soil Mechanics I

Time : Three Hours (50 Marks for each Part) **Full Marks : 100**

Part I (50 Marks)

Use separate answer script for each Part

	Question No.		Marks
CO1 [07]	Q1.	Liquid limit test was conducted on a soil sample. The test data are as follows :	07

Number of blows :	31	35	28	18
Weight of wet soil and container :	25.93	25.27	53.99	24.89
Weight of dry soil and container :	23.97	23.98	52.30	23.40
Weight of container :	20.96	21.99	49.74	21.23

Calculate the liquid limit of the soil sample.

CO2 [10]		**Answer any two from question (2a), (2b) and question (2c) in this block**	
	Q2a.	The grain size analysis of two nos. of coarse grained soil revealed the following information.	05

	Sample-I	**Sample-II**
% Finer than 75 micron	4%	3%
% Finer the 4.75 mm	97%	96%
Uniformity co-efficient cu	7.0	6.5
Co-efficient of curvature cc	1.2	0.85

Find out the classification symbols of the two soil sample

	Q2b.	Visual identification and laboratory test results on a of soil sample are as follows. Write down the classification symbols and description of the soil samples. Colour : Grey Natural Moisture Content : 35.0% Liquid Limit : 42.1% Plastic Limit : 25.9%	05
	Q2c.	Write short note on Dry strength and Dilatancy test for identification of soil	05

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Part I (50 Marks)

	Question No.		Marks
CO3 [08]		**Answer any two from question (3a), (3b) and question (3c) in this block**	
	Q3a.	• What is the critical hydraulic gradient of a sand layer if specific gravity and void ratio are 2.66 and 0.69 respectively?	01
		• A bed of sand consists of three horizontal layers of equal thickness. The value of K for the upper and lower layers is 1.50m x 10^{-4} cm/sec and that of the middle layer is 2 x 10^{-3} cm/sec. What is the ratio of the average co-efficient of permeability of the combined soil layer in the horizontal direction to that in the vertical direction ?	03
	Q3b.	In a falling head permeability test the initial head (at t = 0) is 50cm. The head drops by 4cm in 12 minutes. Calculate the time required to run the test if the final head is to be 20cm.	04
	Q3c.	Derive the expression for equivalent co-efficient of permeability in horizontal direction for a three-layer soil system. The individual layer thicknesses are H_1, H_2 and H_3 while the co-efficient of permeability are k_1, k_2 and k_3 respectively.	04
CO4 [10]	Q4.	The subsoil profile at a site is given below.	10

Depth (m)		Description	Soil Parameters
From	To		
0.0	6.0	Loose brownish grey silty sand	$\gamma = 1.78 t/m^3$
6.0	12.00	Medium stiff grey silty clay	$\gamma = 1.82 t/m^3$
12.00	20.00	Medium dense yellowish brown silty sand	$\gamma = 1.88 t/m^3$

The water table is at ground surface. Draw the variation of total, neutral and effective pressure with depth. If the water table rises to 1.00m above the ground level, what will be the change in effective pressure at 20.00m depth? Take $\gamma_w = 1.00 t/m^3$.

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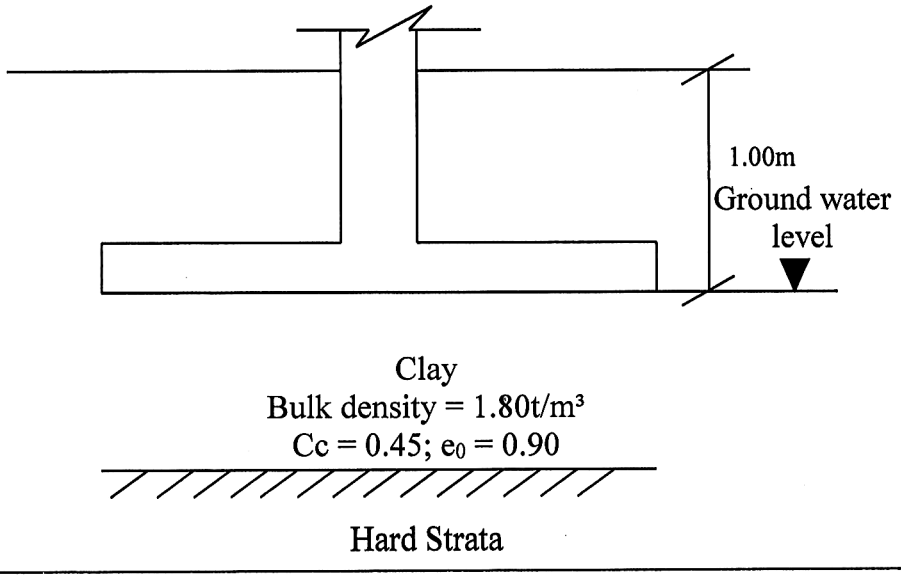
Time : Three Hours **Full Marks : 100**

Part I (50 Marks)

	Question No.		Marks
CO5 [15]		**Answer any three from question (5), question (6), question (7), question (8) and question (9) in this block**	
	Q5.	A 20mm thick undisturbed sample of a saturated clay is tested in the laboratory with drainage being allowed both through the top and bottom surfaces. The soil sample reaches 50 percent degree of consolidation in 60 minutes. If the clay layer from which the sample was obtained is 4m thick and is free to drain through both top and bottom surface, calculate the time required by the clay layer to undergo the same degree of consolidation. What would have been the time of consolidation if the clay layer is free to drain only through the top surface ?	05
	Q6a.	Describe the procedure of determination of field e-log p curve for normally consolidated soil.	2.5
	Q6b.	Describe the method of determination of pre-consolidation pressure.	2.5
	Q7.	A square footing of size 2.00m x 2.00m is placed at a depth of 1.00m below ground level. The footing carries a load of 50 ton from the superstructure. The soil profile is shown below. The ground water table is at ground surface. The clay layer extends up to a depth of 6.0m below ground surface. Calculate the total settlement of the clay strata. 	05

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B. E. CONSTRUCTION ENGINEERING 2ND YEAR 2ND SEMESTER - 2024

SUBJECT: Soil Mechanics I

Time : Three Hours **Full Marks : 100**

Part I (50 Marks)

	Question No.		Marks
	Q8.	A sample of silty clay, 6m thick were tested in a odometer and following results were obtained: Initial void ratio $e_0 = 0.87$ Preconsolidation stress $\bar{\sigma}_c = 13.0$ t/m^2 Recompression index $C_r = 0.03$ Compression index $C_c = 0.28$ Estimate the consolidation settlement if the present average overburden stress of the layer is 7.5 t/m^2 and a uniform surcharge of 8.5 t/m^2 is applied over ground level.	05
	Q9a.	During a consolidation test, void ratio changed from 0.7738 to 0.7714 when the pressure applied from zero to 0.25 kg/cm^2. The initial height of the specimen is 20.0mm. Calculate the change in height of the specimen due to pressure increment. Also calculate the co-efficient of volume compressibility.	03
	Q9b.	For a clay soil, the co-efficient of permeability and co-efficient of volume compressibility are 1×10^{-7} cm/sec and 0.0300cm^2/kg. Find out the co-efficient of consolidation.	02

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B.E Construction Engineering 2nd year 2nd semester Examination 2024

Soil Mechanics-I

Part-II (50 Marks)

Answer any two questions (Assume relevant data , if required)

Q-1 . A proposed earth dam requires 7500 m^3 of compacted soil with relative density of 94% , maximum void ratio of 0.73, minimum void ratio of 0.4 and specific gravity (Gs)=2.67. Two borrow pits are available as described below. Choose the best borrow pit with minimum cost. (8) CO3

Borrow Pit	Degree of saturation %	Moisture content %	Cost (Rs/m^3)
A	82	18.43	10
B	100	24.34	5

(b) Define and explain (i) void ratio (ii) degree of saturation (iii) water content of soil using three phase diagram. (6) CO1

© Explain the significance of stress isobar (5) CO4

(d) A partially saturated sample has a water content of 14 % and the bulk density of 1.88 gm /cm^3 . Determine the degree of saturation and void ratio of soil if the specific gravity of soil is 2.65. (6) CO1

Q-2. (a) CU test result is given below

Cell pressure (kN/m^2)	155	308	452	600
Deviatore stress (kN/m^2)	107	208	306	405

Determine the shear strength parameters using graphical method. (14) CO5

(b) Prove that $C = q_u / 2$ in unconfined compression test. (6) CO5

© Explain Vane shear test . (5) CO5

Q-3. (a) Determine the vertical stress at a depth of 5m below the surface of a rectangular footing (2 m x 3 m) carrying an uniformly distributed load of 10 t/m^2 using 2:1 method. If the same load is substituted as a point load then estimate the vertical stress at same depth using Boussenesq's and Westergaard's theory . Comment on the stresses estimated using different methods. (14) CO4

(b) Estimate the energy ratio between a modified proctor and standard compaction test . (6) CO3

© Discuss the significance of pore pressure parameter in Triaxial test. (5) CO5