Ref. No. CON/PC/B/T/223/2023

B. E. CONSTRUCTION ENGINEERING 2ND YEAR 2ND SEMESTER - 2023

SUBJECT: Soil Mechanics I

Time : Three hours Full Marks : 100

(50 Marks for each Part)

Use separate answer script for each Part

PART I (50 Marks)

Answer any two questions

In solving some numerical problems assume A = last digit of your examination roll number. Assume relevant data if required.

Q-1 (a) Determine the planes of maximum obliquity and maximum shear by constructing Mohr circle for $\sigma_1 = 60A$ kN/m^2 and $\sigma_3 = 20A$ kN/m^2 . CO4 (7)

(b) i)Define Degree of saturation (s) , void ratio (e) and water content (w) .

CO1 (5)

© Discuss different types of rollers used in soil compaction for different types of soil. CO3 (8)

(d) Explain CU and C-D test . CO4 (5)

Q-2. (a) A highway embankment fill needs 500000 cubic meter of soil compacted to a void ratio of 0.75 . There are two borrow pits at Kaksa and Jitpur from where the soil can be taken and transported to the site. CO1 (8)

Borrow pit	In situ void ratio	Transportation cost
Kaksa	0.8A	Rs 10/cubic meter
Jitpur	1.70	Rs 8/ cubic meter

(b) Explain the basic principle of conducting modified Proctor test. Define Optimum moisture content and zero air void line. CO1 (8)

© What should be the target dry density in a highway embankment construction using Modified proctor test data. CO3 (3)

(d) . Discuss the difference between Boussenesq's and Westergaard's theory for determination of vertical stress for point load. CO4 (6)

[Turn over

Q-3. (i) A point load 1000 kN acts on the ground surface. (a) show the variation of vertical stress on a horizontal plane at a depth of 5m below the surface. and (b) show the variation of vertical stress on a vertical plane at a radial distance of 2.0 m from the load . Consider 1m interval for estimation of variation in vertical stress both in horizontal and vertical plane. Prepare tables for stress calculation and show the variation of vertical stress with neat sketch in graph paper . CO4 (15)

(b) Discuss the theory of stress distribution for an embankment load and circular load. CO4 (3+3)

© Explain the significance of stress isobar . CO4 (4)

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(50 Marks for each Part)

Use separate answer script for each Part

PART II (50 Marks)

	Question No.		Marks
CO1 [07]	Q1a.	Chose the correct answer	01
	i)	If soil is dried beyond shrinkage limit, it will show a) Large volume changeb) Moderate volume change c) Low volume change d) No volume change	
	ii)	The liquid limit (LL), plastic Limit (PL) and shrinkage Limit (SL) of a cohesive soil satisfy the relation a) LL>PL <SL b) LL>PL>SL c) LL<PL<SL d) LL<PL>SL	01
	Q1b.	Define the following a) Liquid Limit, b) Plastic Limit, c) Shrinkage limit, d) Plasticity Index, e) Liquidity Index	05
CO2 [10]		**Answer any one from question (2) and question (3) in this block**	
	Q2.	The combined grain size analysis of a soil sample is carried out. The test data are as follows. From sieve analysis, % finer than 0.075mm is 97%. During the hydrometer test, hydrometer reading of 1.012 is obtained at 30 minutes. Total soil sample taken for test : 50 gm Specific gravity of soil solid : 2.67 Viscosity of water : 7.83milipoise Specific gravity of water : 0.9963 Meniscus correction : + 0.0005 Diameter of c/s area of cylinder : 7.2cm Volume of the hydrometer bulb : 100cc h (height of hydrometer bulb) : 16.3cm Distance from neck to hydrometer reading 1.030 is 1.46cm Distance between major graduations, i.e. between 1.025 & 1.030 etc. is 1.75cm. Find out the particle diameter and % finer corresponding to hydrometer reading taken at 30 minutes.	10

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Part II

	Question No.		Marks
	Q3a.	Visual identification and laboratory test results on a soil sample are as follows. Write down the classification symbols and description of the soil sample. Colour : Brownish grey Natural Moisture Content : 36% Liquid Limit : 50% Plastic Limit : 24%	05
	Q3b.	Chose the correct answer	
	i)	A soil having particles of nearly the same size is known as a) well graded b) uniformly graded c) gap graded	01
	ii)	Data from a sieve analysis conducted on a given sample of soil showed that 67% of the particles passed through 75 micron IS sieve. The liquid limit and plastic limit of the finer fraction were found to be 45 and 33 percent respectively. The group symbol of the given soil as per IS:1498-1970. a) SC b) MI c) CH d) MH	01
	iii)	The type of soil represented by "MH" is a) Inorganic silts of high plasticity with liquid limit more than 50% b) Inorganic silts of intermediate plasticity with liquid limit less than 50% c) Inorganic clay of high plasticity with liquid limit more than 50% d) Inorganic clay of low plasticity with liquid limit less than 50%	01
	iv)	**State whether the following statements are true or false.** a) If the dry strength is high, the soil is likely to be clay. b) Dry Density of a soil sample is more than its saturated density.	02

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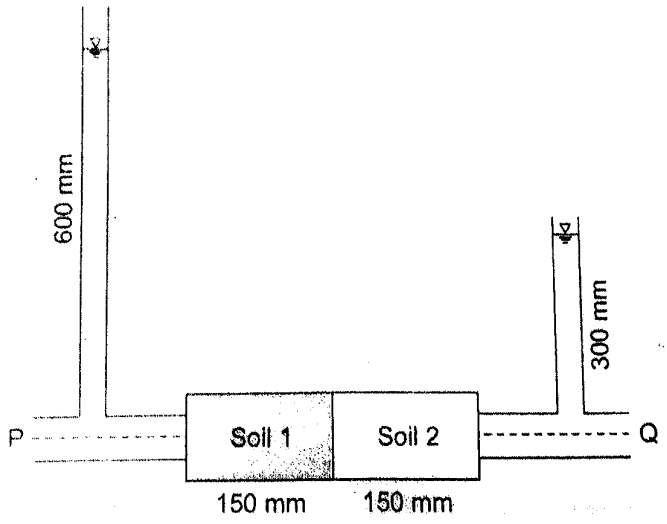
SUBJECT: Soil Mechanics I

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

Part II

	Question No.		Marks
CO3 [08]		**Answer any one from question (4) and question (5) in this block**	
	Q4.	Water flows from P to Q through two soil samples, soil 1 and soil 2 having cross sectional area of 8000mm^2 as shown in Fig A. Over a period of 15 minutes, 200000mm^3 of water was observed to pass through any cross section. The flow condition can be assumed to be steady state. If the Co-efficient of permeability of soil 1 is 0.02mm/sec, find out the co-efficient of permeability of soil 2.  Fig A	08
	Q5a.	The following details refer to following head permeability test conducted at the laboratory Sample thickness : 2.5cm, Diameter of the sample : 7.5 cm Diameter of the stand pipe : 10mm Initial head of water in the stand pipe : 100 cm Water level in the stand pipe after 03h 20min. : 80 cm Determine the co-efficient of permeability of the soil.	05

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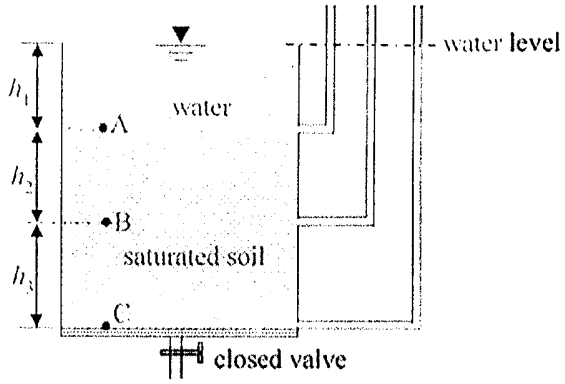
Time : Three Hours **Full Marks : 100**

Part II

	Question No.		Marks
	Q5b.	A soil sample is underlying a water column of height h_1, as shown in the figure. The vertical effective stresses at points A, B, and C are σ'_A , σ'_B and σ'_c, respectively. Let γ_{sat} and γ' be the saturated and submerged unit weights of the soil sample, respectively, and γ_w be the unit weight of water. Which one of the following expressions correctly represents the sum ($\sigma'_A + \sigma'_B + \sigma'_c$,)?  a) $(2h_2 + h_3)\gamma'$ b) $(h_1+h_2+h_3)\gamma'$ c) $(h_2+h_3)(\gamma_{sat} - \gamma_w)$ d) $(h_1+h_2+h_3)\gamma_{sat}$	03
CO4 [10]	Q6.	The sub-soil profile at a site is given below. **Depth (m)** / **From** / **To** / **Description** / **Soil parameters** 0.00 – 5.00 : Loose brownish grey silty sand — Bulk density : 1.850t/m³ 5.00 – 12.00 : Medium dense grey silty sand — Bulk density : 1.950t/m³ 12.00 – 15.00 : Dense yellowish brown silty sand — Bulk density : 1.980t/m³ The ground water table is at ground surface. Draw the variations of total, effective and neutral pressure with depth. If the water table is lowered by 1.0m below ground level, what will be the changes in effective pressure at 15.00m depth?	10

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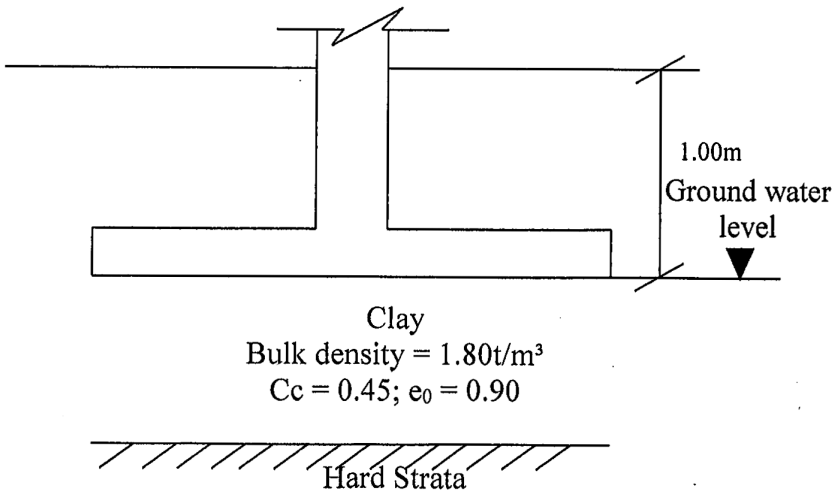
Time : Three Hours **Full Marks : 100**

Part II

	Question No.		Marks
CO5 [15]		**Answer any three from question (7), question (8), question (9) and question (10) in this block**	
	Q7a.	The void ratio of a soil is 0.55 at an effective normal stress of 1.40 kg/cm^2. The compression index of the soil is 0.25. In order to reduce the void ratio to 0.4, what will be the increase in the magnitude of effective normal stress?	02
	Q7b.	In a consolidation test a specimen of fully saturated clay has been consolidated under a vertical pressure of 2.5t/m^2 and is presently at equilibrium. The effective stress and pore water pressure immediately on increasing the vertical stress to 50kN/m^2, respectively are i) 5.0 t/m^2 and zero, ii) 2.5 t/m^2 and 5.0 t/m^2 iii) 2.5 t/m^2 and 2.5t/m^2 iv) zero and 5.0t/m^2	01
	Q7c.	Explain the following Normally consolidated clay and over consolidated clay	02
	Q8.	The time to reach 60% consolidation is 40 seconds for a sample of 20mm thick tested in laboratory under condition of double drainage. How many years will the corresponding layer in a project site require to reach the same degree of consolidation if it is 10.0m thick and drained on one side only?	05
	Q9.	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 1.0m below ground level. Calculate the total settlement of the clay strata.  	05

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

Part II

<table>
<tr><th></th><th>Question No.</th><th></th><th>Marks</th></tr>
<tr><td></td><td>Q10.</td><td>The consolidation test data of a soil sample collected from a depth of 5.0m below ground level is given below :
<table>
<tr><td>Pressure (kg/cm²)</td><td>0</td><td>0.25</td><td>0.50</td><td>1.0</td><td>2.0</td><td>4.0</td><td>8.0</td><td>2.0</td><td>0.5</td></tr>
<tr><td>Dial gauge reading</td><td>2250</td><td>2230</td><td>2185</td><td>2075</td><td>1875</td><td>1550</td><td>1210</td><td>1259</td><td>1310</td></tr>
</table>
One small division of dial gauge = 0.002mm. Diameter and height of consolidation ring are 60mm and 20mm respectively. Specific gravity of the soil solid = 2.68. Dry weight of the soil sample = 82.0 gm. Calculate the void ratio and co-efficient of volume compressibility mv corresponding to each pressure and pressure range respectively.</td><td>05</td></tr>
</table>