U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 22CV4PCGTE **Max Marks: 100**
Course: Geotechnical Engineering-1

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	With a phase diagram define the following: i) Porosity ii) Bulk density ii)Water content iv) Mass specific gravity	1	1	**6**
	b)	A partially saturated soil sample from a test pit has a bulk unit weight of 18.5 kN/m^3 and a natural water content of 12.5 %. The specific gravity of soil solids is 2.67. Determine the degree of saturation and void ratio. In case the soil gets saturated, what will be its unit weight on saturation?	1	1	**8**
	c)	List the different types of transported soils and the agency which transports them. Explain the characteristic feature of alluvial deposits.	1	1	**6**
		UNIT - II			
2	a)	A cone penetration test was conducted on a soil sample to determine its liquid limit and readings recorded are presented in Table 1. Determine the liquid limit of the soil. The natural water content of the soil was 40.0%. The plastic limit of the soil was ascertained independently and was found to be 30.3 %. Table 1: Cone penetration test data (Q. 2a) Depth of penetration (mm): 24.8, 23.5, 21.2, 19.5, 16.5 Water content (%): 59.5, 58.1, 55.9, 54.5, 52.2 Using the data given in Table 1, determine the following: i) Liquidity index ii) Consistency index	1	1	**8**
	b)	In a sandy deposit above the water table, it was found to have a natural water content of 12.8 % and a unit weight of 18.8 kN/m^3.	2	2	**6**

			Laboratory test on a dried sample indicated minimum void ratio, e_{min}= 0.47 and maximum void ratio, e_{max}= 0.79 for the densest and loosest states respectively. Compute the suitable parameter that indicates the state of compactness of the soil in the field. Assume G_S = 2.70. Also find the degree of saturation of the soil. If driven piles have to be adopted in this soil, suggest whether it is advisable to go with driven piles. If yes why? If not give reasons why it is not suitable to adopt driven pile system in that soil.			
		c)	Data obtained by GSD curves of two soil samples A and B is presented in Table 2 Table 2: Grain size distribution properties of soils A and B (Q. 2c) Characteristic / Soil A / Soil B Gravel (%) / 60 / 35 Sand (%) / 40 / 65 D_{60} / 0.41 / 0.39 D_{30} / 0.35 / 0.20 D_{10} / 0.25 / 0.04 Find Cu and Cc. Comment on the gradation of each of the soils. Which of the two samples do you prefer for the construction of a highway embankment? Give reasons.			**6**
			OR			
	3	a	List the assumptions made in sedimentation analysis using Stoke's law. Also state their limitations.			**8**
		b	What are the gradation parameters used for grading coarse grained soils? State their values for gravel or sand to be considered as well graded			**6**
		b	The results of sieve analysis carried on a soil gave the following results. Sand = 28%, Silt (size) = 3%, and Clay (size) = 1%; D_{10} = 0.009 mm, D_{30} = 0.22 mm, D_{60} = 1.6 mm. Classify the soil as per Indian Standard Soil Classification system.			**6**
			UNIT - III			
	4	a)	What are the three most common clay minerals of engineering significance? With a neat sketch describe one clay mineral which if present in the natural expensive clay. Also give reason for the soil to have the maximum swelling due to the presence of that mineral and give the common values of specific surface area, Cation Exchange Capacity (CEC) of the clay mineral.	1	1	**8**
		b)	Determine the total and effective vertical stresses and pore water pressure. Plot their variation with depth for the soil profile shown.	2	2	**12**

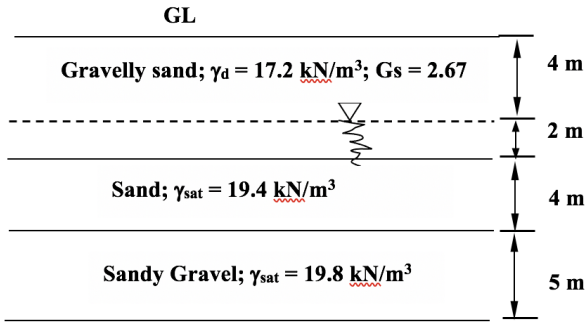

Fig. Q.4 (b)

		UNIT - IV				
5	a)	From an undisturbed chunk soil sample obtained from the field, a portion of the undisturbed sample was extracted to fit into in a standard permeameter apparatus such that the stratification of the soil in the field was retained in the laboratory. The soil sample was 150 mm long and 3848.45 mm^2 in cross-section. A constant head of 250 mm was maintained such that the flow was perpendicular to the stratification. The discharge yielded was. $225x10^2$ mm^3 in a time of 2 mins. Compute the coefficient of hydraulic conductivity, coefficient of percolation, the seepage velocity and discharge velocity, given that the void ratio of the soil sample is 0.58. Based on the results obtained comment on the type of soil.	2	2	**10**
	b)	List and explain with neat sketches the factors that affect the compaction characteristics of soils.	2	2	**10**
		OR				
6	a)	Explain with neat sketches the effect of soil type and amount of compaction energy imparted on compaction characteristics of soils.	2	2	**6**
	b)	Table 3 presents the results of a standard compaction test conducted on a soil sample to be used for construction of an embankment for a highway project.	2	2	**8**

Table 3: Compaction test data (Q. 6b)

Water content (%)	8.8	11.4	14.5	16.6	18.4	20.4	21.8
Bulk unit weight (kN/m^3)	15.8	16.9	18.2	19.0	19.2	19.1	18.9

Plot the dry unit weight versus moisture content and obtain the compaction characteristics. Also, show100% saturation line on the plot. Take G_s = 2.68.

<table>
<tr><td></td><td></td><td>c)</td><td>What is seepage velocity and discharge velocity? Derive a relation between coefficient of permeability and coefficient of percolation.</td><td>2</td><td>2</td><td>6</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>In a direct shear test on a specimen of clean dry sand, a normal stress of 155 kN/m^2 was applied and failure occurred at a shear stress of 75 kN/m^2.
Determine graphically:
(i) the angle of shearing resistance, (ii) the principal stresses during failure, and (iii) the directions of the principal planes with respect to the direction of the plane of shearing.</td><td>2</td><td>2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Undrained triaxial tests are carried out on four identical specimens of silty clay and the results obtained are tabulated in Table 5. Analytically determine the value of the effective angle of shearing resistance and the cohesion intercept.
Table 5: Results of triaxial shear test (Q. 7b)
<table><tr><td>Cell Pressure (kN/m^2)</td><td>50</td><td>100</td><td>200</td></tr><tr><td>Deviator stress at failure (kN/m^2)</td><td>260</td><td>360</td><td>540</td></tr><tr><td>Pore-water pressure (kN/m^2)</td><td>5</td><td>10</td><td>18</td></tr></table></td><td>2</td><td>2</td><td>10</td></tr>
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