Please check that this question paper contains 9 questions and 3 printed pages within first ten minutes

[Total No. of Questions: 09] [Total No. of Pages: 03]

Uni. Roll No. …….

Program: **B.Tech**
Semester: **5th**
Name of Subject: **Geotechnical Engineering**
Subject Code: **PCCE - 114**
Paper ID: **16391**

18-01-2022(E)

Time Allowed: 02 Hours **Max. Marks: 60**

NOTE:

1) Each question is of 10 marks.
2) Attempt ***any six questions*** out of nine.
3) Any missing data may be assumed appropriately.

Questions:

1.

(a) The values of liquid limit and plasticity index of a soil were reported as below: w_L = 36% and I_p = 10%. If the sample of this soil is dried from its state at plastic limit, the volume change is 28% of its own volume. Similarly, when the sample is dried from its state of liquid limit, the volume change is 40% of its own volume at liquid limit. Determine the shrinkage limit. What is shrinkage ratio and volumetric shrinkage?

(b) A local soil is found to have plasticity index (P.I) of 15. It is mixed with sand having PI of zero to obtain a mix having PI of 6. What shall be the percentage of sand in the mix?

2.

(a) Prove that the water content (w) of a partially saturated soil can be expressed as

$$w = \frac{1 - \left(\frac{G_m}{G}\right)}{\left(\frac{G_m}{S}\right) - 1}$$

where, G_m = mass specific gravity, G = specific gravity of solids and S = degree of saturation.

(b) A soil sample in its natural state has, when fully saturated, a water content of 32.5%. Determine the void ratio, dry and total unit weights. Calculate the total weight of water required to saturate a soil mass of volume $10m^3$. Assume G_s = 2.69.

3. An isolated rectangular footing having size 3m x 2m transmits a vertical column load of 870kN to the sub soil. The sub soil consists of a bed of dense sand, containing two strata of clay, each 3m thick. The top of the upper stratum is 6m below the ground and of the lower 21m below ground. The compression index for both layers is 0.35, the water content is 34% and specific gravity of soil grains is 2.75. The sand weighs $20kN/m^3$ and is completely submerged. Compute the total settlement under the given load.

4. Explain in detail the step by step procedure for classification of a soil by Indian standard classification system.

5.

(a) In a falling head permeameter if the time intervals for drop in levels from h_1 to h_2 and h_2 to h_3 are equal, prove that; $h_2 = \sqrt{h_1 \times h_3}$

(b) A canal is cut into a soil with a stratigraphy shown in Figure-1. Assuming flow takes place laterally and vertically through the sides of the canal and vertically below the canal, determine the equivalent hydraulic conductivity in the horizontal and vertical directions. The vertical and horizontal hydraulic conductivities for each layer are assumed to be the same. Calculate the ratio of the equivalent horizontal hydraulic conductivity to the equivalent vertical hydraulic conductivity for flow through the sides of the canal.

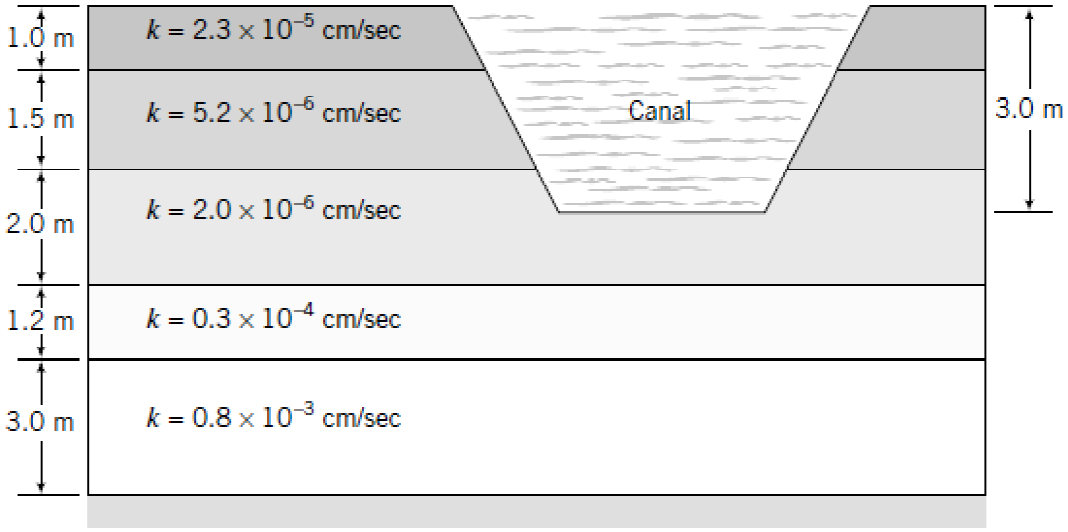

Figure 1

6. What is the effect of compaction on the engineering properties of the soil? How would you decide whether the soil should be compacted the dry of the optimum or the wet of the optimum? Also explain how the result of compaction test be used to select the range of water content that can be allowed to secure a relative compaction of 96% in the field?

7.

(a) A sample, 75 mm in diameter and 20 mm high, taken from a clay layer 10 m thick, was tested in an oedometer with drainage at the upper and lower boundaries. It took the laboratory sample 15 minutes to reach 50% consolidation. If the clay layer in the field has the same drainage condition as the laboratory sample, calculate how long it will take the 10m clay layer to achieve 50% and 90% consolidation. How much more time would it take the 10m clay layer to achieve 50% consolidation if drainage existed on only one boundary?

(b) A homogeneous clay layer, 9 m thick, is expected to have an ultimate settlement of 308 mm. After a time span of 2 years, the average settlement was measured to be 108 mm. How much longer will it take for the average settlement to attain 220 mm?

8. The following results were obtained from consolidated-undrained tests on specimen of saturated normally consolidated clay.

Cell pressure (kN/m^2)	100	200	300
Ultimate deviator stress (kN/m^2)	137	210	283
Ultimate pore pressure (kN/m^2)	28	86	147

Determine:

(a) the effective stress parameters c' and ϕ'

(b) the apparent undrained strength parameters c_{cu} and ϕ_{cu}

9.

(a) Define slow, quick and consolidated quick triaxial shear test, illustrating their use by atleast one field example.

(b) Compute and plot the total, effective and pore pressure distribution diagrams up to a depth of 20m below the bottom of a lake 6m deep. The bottom of the lake consists of soft clay with thickness of more than 20m. The average water content of the clay is 35% and the specific gravity of the soil may be assumed to be 2.65.

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