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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination July 2021 (2019 Scheme)

Course Code: CET204

Course Name: GEOTECHNICAL ENGINEERING – I

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	Derive the relationship between void ratio and porosity.	3
2	Differentiate between sensitivity and thixotropy.	3
3	Name and define the two forces which retard the downward velocity of a particle settling in suspension.	3
4	Write the equations to find the horizontal and vertical permeability of stratified soils.	3
5	Explain the concept of critical hydraulic gradient using the phenomenon of quick sand condition. In which type of soils, the quick sand condition can be observed?	3
6	What is Newmark's chart? How is vertical stress at any point in the soil mass determined using this chart?	3
7	What are normally consolidated, over consolidated and under consolidated soils?	3
8	Point out any three differences between the compaction and consolidation processes.	3
9	What are CU and CD tests?	3
10	Differentiate between toe failure and slip failure of slopes with neat sketches.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	How is specific gravity of a soil sample determined in the lab? Explain with neat sketches.	5
	b)	A 1000 cc core cutter weighing 946.80 g was used to find out in-situ unit weight of an embankment. The weight of core cutter filled with soil was noted to be 2770.60 g. Laboratory tests on the sample indicated a water content of 10.45% and specific gravity of solids of 2.65. Determine bulk unit weight, dry unit	9

weight, void ratio and degree of saturation of the sample. If the embankment gets saturated due to rains, calculate the water content and the saturated unit weight (assume there is no volume change in sample on saturation).

12 a) Derive the relationship between bulk unit weight and water content of soil using the concept of the three phase soil system. 5

b) 1 cu.m. of wet soil weighs 20 kN. Its dry weight is 18 kN and the specific gravity of solids is 2.67. Determine the water content, porosity, void ratio and the degree of saturation. Also draw a phase diagram for the given condition. 9

Module -2

13 a) List the limitations of using Stoke's law in sedimentation analysis. 5

b) A test for the relative density of soil in place was performed by digging a small hole in the soil. The volume of the hole was 400 ml and the moist weight of the excavated soil was 9 N. After oven drying, the weight was 7.8 N. Of the dried soil, 4 N was poured into a vessel in a very loose state, and its volume was found to be 270 ml. The same weight of soil when vibrated and compacted had a volume of 200 ml. Determine the relative density. 9

14 a) Sketch a flow curve and explain its uses. 5

b) An undisturbed soil sample of clay brought from the field was noted to have a volume of 18.0 cc and weight of 30.8 g. On oven drying, the weight of the sample was reduced to 20.5g. The volume of dried sample as obtained by displacement of mercury was 12.5 cc. Calculate shrinkage limit and the specific gravity of solids. What is the shrinkage ratio? 9

Module -3

15 a) Compute the critical hydraulic gradients for the following materials. 5

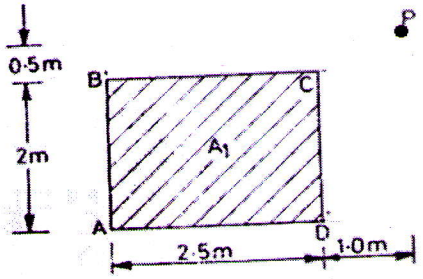
(a) Coarse gravel, k = 100 mm/s, G = 2.67, e = 0.65

(b) Sandy Silt, k = 10^{-7} mm/s, G = 2.67, e = 0.80.

b) An 8 m thick layer of stiff saturated clay (γ = 19 kN/m^3) is underlain by a layer of sand. The sand is under artesian pressure of 5 m. Calculate the maximum depth of cut that can be made without a heave. 9

16 a) Give the principles of any two approximate methods for the determination of vertical stress in a soil mass. 5

b) A rectangular loaded area 2 m x 2.5 m carries a load of 80 kN/m^2. Determine the vertical stress at point P located outside the loaded area at a depth of 2.5 m. 9



Module -4

17 a) Neatly sketch the shape of an e- log p curve and mark the salient features after drawing the unloading and reloading curves too in it. 5

b) For a normally consolidated clay specimen drained on both sides, the following data are given. 9

$\sigma_0 = 30$ kPa; $e = e_0 = 1.1$

$\sigma_0 + \Delta\sigma = 60$ kPa; $e = 0.9$

Thickness of clay specimen = 25.4 mm

Time for 50% consolidation = 2 min

Determine the hydraulic conductivity (mm/s) of the clay for the loading range.

How long (in days) will it take for a 2 m clay layer in the field (drained on one side) to reach 60% consolidation?

18 a) Mention the principle employed in the field compaction of (a) coarse grained soils (b) fine grained soils. Name any 3 equipment employed in each case. 5

b) In a standard proctor test, 1.8 kg of moist soil was filling the mould (volume = 944 cc) after compaction. A soil sample weighing 23 g was taken from the mould and oven dried for 24 hours at a temperature of 110°C. Weight of the dry sample was found to be 20 g. Specific gravity of soil solids is G = 2.7. What is the theoretical maximum value of the dry unit weight of the soil at that water content? 9

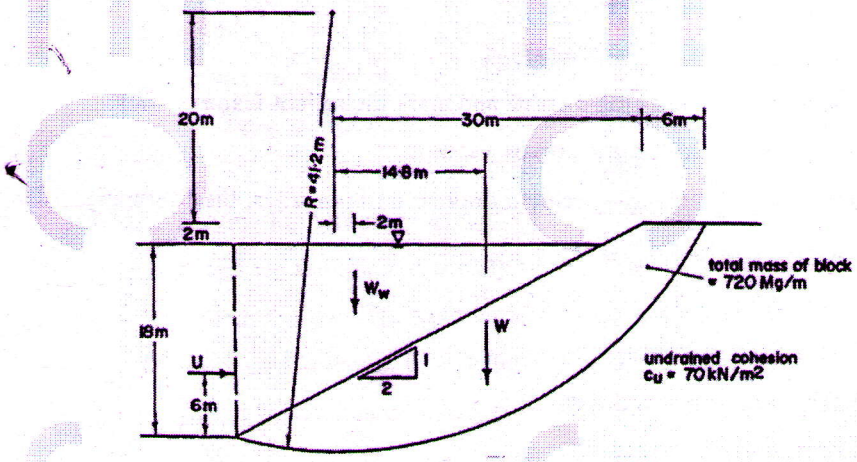
Module -5

19 a) Name 5 geotechnical structures in the design of which the shear strength of soil plays a major role. 5

b) Neatly sketch the typical test results obtained from direct shear tests conducted on for sands and clays. 9

20 a) List out the steps to measure the shear strength of soil using the field vane shear test. Write the equation to determine the shear strength of soil using the same. 5

b) Evaluate the short-term stability for the dam shown in Fig. given below. The embankment consists of a saturated soil for which the angle of shearing resistance $\phi_u = 0$ and the undrained cohesion $c_u = 70$ kN/m^2. The calculation is to be carried out for the reservoir depth of 18 m and for the case where the reservoir has been completely emptied. 9



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