



# P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Civil Engineering

Semester End Examination; Dec. - 2019

Basic Geotechnical Engineering

Time: 3 hrs

Max. Marks: 100

Note: Answer FIVE full questions, selecting ONE full question from each unit.

## UNIT - I

- 1 a. Distinguish Kaolinite from Montmorillonite clay mineral. 6
- b. With usual notations, prove that  $r_d = \frac{G_{rw}}{1+e}$ . 6
- c. A natural soil has a bulk unit weight of  $18 \text{ kN/m}^3$  and water content of 8%. Calculate the amount of water required per cu.m of soil to raise the water content to 18% what will be the degree of saturation at this water content? Assume constant void ratio and take  $G = 2.7$ . 8
- 2 a. Explain diffuse double layer theory. 6
- b. Define the terms;
- i) Porosity ii) Water content 6
- iii) Specific gravity of soil solids iv) Dry unit weight of soil
- c. For a soil in its natural state void ratio, water content and specific gravity are respectively 0.8, 0.24 and 2.68. Determine bulk unit weight, dry unit weight and degree of saturation. If the soil is completely saturated by adding water, what would be its water content and saturated density? 8

## UNIT - II

- 3 a. Explain the steps involved in the determination of dry unit weight of soil at a site from sand replacement method. 8
- b. Draw the particle size distribution curve for soil with uniform particle sizes. Find  $C_u$  and  $C_c$  for the same. 4
- c. Sieve analysis was carried out for a soil sample of 1000 g from a site. The weights of soil collected on each sieve are presented in table below. Find the coefficients of uniformity and curvature. 8

Sieve Size (mm)	4.75	2.36	1.18	0.600	0.425	0.300	0.212	0.150	0.075
% passing	94	83	68	51	40	28	19	13	5

- 4 a. How is water content determined in the field quickly? 4
- b. What is the significance of plasticity chart? Explain with a neat sketch. 8
- c. The following table gives the index properties of soils of 3 different types. classify the soils as per Indian standard:

Soil type	% gravel	% fines	$C_u$	$C_c$	$W_L$	$W_p$
A	20	60	--	--	50	35
B	40	10	14	2	35	27
C	51	2	10	1.6	--	--

## UNIT - III

- 5 a. Distinguish between proctors and modified proctors test. 4

- b. Derive the expression for coefficient of permeability from variable head permeability test. 8
- c. The following are the results of standard compaction test on a soil. Plot the compactor curve and get MDD and OMC. Show 100% saturation line on the plot. Take;  $G = 2.65$ .

Water content (%)	13.5	20.2	25.0	35.0	41.5
Bulk unit weight (kN/m <sup>3</sup> )	16.3	19.4	18.8	18.0	17.2

- 6 a. Obtain the relationship between seepage and superficial velocities. 4
- b. Discuss the effect of compaction on engineering properties of soil. 8
- c. In a falling head permeability test, the initial head of 1.0 m dropped to 0.35 m in 3 hours, the diameter of stand pipe being 5 mm. The soil specimen was 200 mm long and 100 mm in diameter. Calculate the coefficient of permeability of soil. 8

**UNIT - IV**

- 7 a. Explain a method of determining pre-consolidation pressure. 6
- b. 20 mm thick undisturbed sample of saturated clay is tested in laboratory with drainage allowed through top and bottom. Sample reaches 50% consolidation in 35 minutes. If clay layer from which sample was obtained 3 m thick and is free to drain through top and bottom surface, calculate the time required for same degree of consolidation in the field. What is time required if the drainage is allowed only from top? 8
- c. Compute total, effective and pore pressure at a depth of 20 m below the bottom of a lake 6 m deep. The bottom of the lake consists of soft clay with a thickness of more than 20 m. The average water constant and specific gravity are 35% and 2.65 respectively. Draw the pressure distribution curves. 6
- 8 a. Explain the determination of coefficient of consolidation by logarithmic fitting method. 6
- b. In a consolidation test, the void ratio of sample of soil decreased from 1.2 to 1.1 when the pressure increased from 160 to 320 kN/m<sup>2</sup>. Calculate the coefficient of consolidation, if the coefficient of permeability is  $8 \times 10^{-7}$  mm/s. 8
- c. A granular soil deposit is 7 m deep over an impermeable layer. The ground water table is 4 m below the ground surface. The deposit has a zone of capillary rise of 1.2 m with a saturation of 50%. Plot the variation of total, effective and pore water pressures with the depth of deposit. Take void ratio and specific gravity of 0.6 and 2.65 respectively. 6

**UNIT - V**

- 9 a. Discuss Mohr coulomb failure criteria for the determination of shear strength of soil. Sketch the Mohr diagram for direct shear test a failure and explain. 6
- b. Compare the merits and demerits of direct shear test over triaxial shear test. 6
- c. In a direct shear test on a sand sample, the normal stress was 200 kN/m<sup>2</sup> and the sample failed at a shear stress of 120 kN/m<sup>2</sup>. Draw the Mohr circle and strength envelope. Determine angle of shearing resistance, magnitudes of major and minor principal stresses and orientation of principal planes. 8
- 10 a. Discuss the different drainage paths and their significance in shear tests. 6
- b. Discuss the principle and application of vane shear test. 6
- c. A cylindrical specimen of saturated soil fails under an axial stress of 150 kN/m<sup>2</sup> in an unconfined compression test. The failure plane makes an angle of 52° with the horizontal. Calculate cohesion and angle of internal friction of soil. 8