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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Civil Engineering

Semester End Examination; Dec. - 2014

Geotechnical Engineering - I

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.*
ii) Assume suitable missing data if any

PART - A

1. a. Explain the geological cycle and formation of soil. 6

   b. Distinguish between i) Primary and Secondary Valance Bonds
   ii) Kaolinite and Montmorillonite clay minerals. 8

   c. Explain electrical double layer theory. 6

2 a. Considering the soil as a 3-phase system, derive an expression for the dry density of soil in the form $\gamma_d = \frac{(1-n_a)G\gamma_w}{1+WG}$ with usual notations. 6

   b. Explain the IS method of determination of specific gravity of clay samples. Mention the importance of temperature correction. 6

   c. A sample of sand above the water table was found to have a natural water content of 15% and a unit weight of 18.84 kN/m^3. Laboratory tests on dried sample indicated e_{min} = 0.5 and e_{max}= 0.85 for the densest and loosest states respectively. Compute the degree of saturation and relative density. Assume G = 2.65. 8

3 a. Explain the composite correction to be applied to hydrometer reading. 6

   b. Classify the soils as detailed below according to IS approach.

Sample	I	II
% passing through 4.75mm	90	80
% passing through 0.075mm	3	60
Liquid Limit (%)	-	60
Plastic Limit (%)	_	25
D_{10} (mm)	1	-
D_{30} (mm)	2	-
D_{60} (mm)	3	-

6

   c. Following are the results obtained from grain size analysis of a soil. Plot the grain size distribution curve and determine the percentage of sand size, gravel size and fines size as per IS. Also calculate coefficients of Curvature and uniformity. 8

Contd….2

Sieve Size (mm)	4.75	2.36	1.18	0.60	0.425	0.30	0.212	0.15	0.075	Pan
Weight of soil retained (g)	60	110	150	170	110	120	90	60	80	50

4 a. Derive the expression for coefficient of permeability as obtained in variable head permeability tests. 6

b. Discuss the factors influencing permeability. 6

c. A soil profile consist of three layers with properties shown in the table below. Calculate the equivalent coefficients of permeability parallel and normal to the stratum. 8

Layer	Thickness(m)	K(m/s)
1	3	2×10^{-6}
2	4	$5x\ 10^{-8}$
3	3	3×10^{-5}

PART - B

5 a. Discuss the effect of compaction soil properties. 6

b. Explain the relevance of proctors needle. 4

c. The results of compaction test on a soil are given below. Plot the compaction curve and determine MDD and OMC. If G= 2.68, determine the percentage air voids at MDD 10

Water content %	9.0	10.2	12.5	13.4	14.8	16.0
Bulk unit Weigh (kN/m^3)	19.23	20.51	22.20	22.20	21.79	20.96

6 a. Distinguish between compaction and consolidation. 4

b. 20mm 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 is 3 m thick and is free to drain through top and bottom surfaces, calculate the time required for same degree of consolidation in field. What is the time required if the drainage in field is only through top.. 8

c. A clay layer 3.66 m rests beneath a deposit of submerged sand 7.92 m thick. The top of the sand is located 3.05 m below the surface of lake. γ_{sat} for sand and clay is 19.62 kN/m^3 and 18 kN/m^3 respectively. Compute total vertical pressure, pore water pressure and effective pressure at themed height of clay layer. 8

7 a. Explain rectangular hyperbola method of determination of coefficient of consolidation. 6

b. List the assumptions of 1D consolidation test and validate each of them. 6

c. The following table gives void ratios at different consolidation pressures during 1D consolidation test. Determine the pre consolidation pressure. Check whether the soil is over consolidated or not. Also determine he compression index in normally consolidated range. 8

Contd….3

σ^1(kPa)	10	20	50	100	200	400	800
e	1.498	1.448	1.370	1.162	1.000	0.840	0.660

8 a. Explain Mohr Coulomb Yield Criterion. Draw failure envelops for sand, pure clay and C-∅ soil. 8

b. List the advantages of triaxial over the direct shear test. 4

c. When an undrained triaxial compression test was conducted on a specimen of clayey silt, the following results were obtained. Determine the shear parameters considering
i) total stress and ii) effective stress. 8

Specimen M_0	1	2	3
σ_1(kN/m^2)	157	204	225
σ_3(kN/m^2)	17	44	56
σ_4(kN/m^2)	12	20	22

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