Code No: V3201 **R07** **Set No: 1**

III B.Tech. II Semester Supplementary Examinations, December - 2012

GEOTECHNICAL ENGINEERING

(Civil Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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Note: Semi log and ordinary Graph Papers are to be supplied

1. (a) What is meant by weathering? Describe its agents, process and effects on rocks.
   (b) A soil specimen has a moisture content of 21.4 %, void ratio of 0.72, and $G_s = 2.70$. Determine
   (i) Bulk density and degree of saturation
   (ii) The new bulk density and void ratio, if the specimen is compressed undrained until full saturation is obtained.

2. A 500 g sample of dry soil was used for a combined sieve and hydrometer analysis (152 H type Hydrometer, L =16.3-0.16417R). The soil mass passing through the 75 μ sieve = 120 g. Hydrometer analysis was carried out on a mass of 40 g that passed through the 75 μ sieve. The average temperature recorded during the test was 30°C.
   Given: G_s = 2.55, C_m (meniscus) = 0.50, C_o = +2.5, η = 8.15 x 10^{-3} poises.
   The actual hydrometer reading R_a = 15.00 after a lapse of 120 min after the start of the test. Determine the particle size D and percent finer.

3. (a) Explain the phenomenon of capillary rise in soil and develop an expression for the capillary rise.
   (b) A sand deposit contains three distinct horizontal layers of equal thickness of 1 m each. The coefficient of permeability of the upper and lower layers is 10^{-3} cm/sec and that of the middle is 10^{-2} cm/sec. What are the equivalent values of the horizontal and vertical hydraulic conductivities of the three layers, and what is their ratio?

4. (a) Explain the graphical procedure of drawing the phreatic line in a homogeneous earth dam provided with a toe drain.
   (b) Determine the seepage loss through the foundation of an earth dam if the flow net has 10 equipotential drops and 4 flow channels. The length of the dam is 300 m and the coefficient of permeability of the soil is 2.5×10^{-4} cm/sec. The level of water above the base of the dam is 12 m on upstream and 2 m on the downstream.

5. (a) Discuss the Construction of Newmark's Influence Chart. What are the uses of this chart?
   (b) A water tower has a circular foundation of 10m diameter. If the total weight of the tower, including foundation is 2.5×10^4 kN, calculate the vertical stress a depth of 3.0m below the foundation level. Also calculate stress at 1.5m depth.

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6. (a) What is compaction curve? Discuss the factors affecting compaction
   (b) The following results were obtained in a compaction test

Bulk Unit weight (kN/m^3)	18.81	20.07	20.52	21.06	21.00	20.04
Water content (%)	7.4	9.7	10.5	11.5	13.1	14.4

   Determine the optimum moisture content and maximum dry density. Draw zero air voids Line.

7. (a) Define pre-consolidation pressure. In what ways is its determination important in soil engineering practice? Describe a suitable procedure for determining the preconsolidation pressure.
   (b) A 3m thick clay layer, beneath a building is overlain by a permeable stratum and is underlain by an impervious rock. The coefficient of consolidation of the clay was found to be 0.025 cm^2/minute. The final expected settlement for the layer is 8 cm.
   (i) How much time will it take for 80% of the total settlement to take place?
   (ii) Determine the time required for a settlement of 2.5 cm to occur.
   (iii) Compute the settlement that would occur in one year.

8. (a) Explain direct shear test in detail. What are the advantages and limitations of it?
   (b) Write a brief note on:
   (i) Mohr stress circle and Mohr – Coulomb's strength envelop.
   (ii) Vane shear test.

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1. (a) Define the following terms with the help of phase diagram:
   (i) void ratio,
   (ii) percentage air voids,
   (iii) water content
   (iv) degree of saturation.

   (b) The moisture content of a specimen of clay soil is 22.4%. The specific gravity of the solids is 2.71.

   (i) Plot the variation of void ratio with degree of saturation and calculate the void ratio, and the dry and wet densities at 50 % saturation.

   (ii) A sample of this soil with initial degree of saturation of 50% is isotropically compressed to achieve a void ratio of 0.55. Calculate the volume change in terms of percentage of the initial volume. How much of this volume change is due to the outward flow of water from the sample?

2. (a) Briefly describe the procedure to determine the liquid limit of a soil.
   (b) The sieve analysis and consistency limit tests conducted on a soil sample gave the following results:
   Percent passing 4.75 mm sieve = 82; Percent passing 75 micron sieve = 9; D_{10} = 0.11 mm; D_{30} = 0.45 mm; D_{60} = 1.12 mm; Liquid limit = 22%; Plastic limit =12%. Classify the soil by Indian Standard Classification.

3. (a) Explain the constant head method for determining the permeability of soil and derive the equation used.
   (b) A soil sample 90 mm high and 6000 mm^2 in cross-section was subjected to a falling head permeability test. The head fall from 500 mm to 300 mm in 1500 sec. The permeability of the soil was 2.4×10^{-3} mm/s. Determine the diameter of the stand pipe.

4. (a) What is quick sand condition? Derive the expression for the critical hydraulic gradient.
   (b) A flow net for calculating the seepage under a sheet pile wall was drawn. The coefficient of permeability of sand was 8×10^{-4} cm/sec. There were 5 flow paths and 14 equipotential drops in the flow net. The head causing flow was 5.0 m. Estimate the quantity of seepage in m^3/day/m length of the sheet pile wall. Also show the typical flow net below the sheet pile wall.

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5. (a) Discuss the essential differences between Boussinesq's and Westergaard's theories.
(b) A reinforced concrete water tank of size 6m × 6m and resting on ground surface carries a uniformly distributed load of 200 kN/m^2. Estimate the maximum vertical pressure at a depth of 12m meters vertically below the centre of the base.

6. (a) What is the effect of compaction on engineering properties of soils?
(b) The following results were obtained from a standard compaction test on a sample of soil.

Water Content (%)	12	14	16	18	20	22
Mass of the Soil (kg)	1.68	1.85	1.91	1.87	1.87	1.83

The volume of the mould used was 950 cm^3. Make necessary calculations and plot the compaction curve and obtain the maximum dry density and optimum water content. Also calculate the void ratio, the degree of saturation and the theoretical maximum dry density. (G = 2.70).

7. (a) Explain in detail square root of time fitting method for evaluation of coefficient of consolidation from laboratory test data.
(b) A saturated soil has a compression index of 0.25. Its void ratio at a stress of 10 kN/m^2 is 2.02 and its permeability is 3.4×10^{-7} m/sec. Compute:
(i) Change in void ratio if the stress is increased to 200 kN/m^2, (ii) Settlement if the soil stratum is 5m thick; and (iii) Time required for 40% consolidation, if drainage is one-way.

8. (a) Describe how a triaxial test is performed on clay specimens in the laboratory.
(b) The following data were obtained from triaxial test conducted on soil samples of 38.1 mm diameter and 76.2 mm in height:

Confining Pressure (kN/m^2)	150	300	450
Deviator stress (kN/m^2	200	275	350

Determine the shear parameters of the soil.

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1. (a) What are the common minerals available in Clay? Describe the properties of each minerals.
   (b) A partially saturated sample from a barrow pit has a natural water content of 10% and a bulk unit weight of 21 kN/m^3. The specific gravity of solids is 2.67. Determine the degree of saturation and void ratio. What will be the unit weight of the sample on full saturation?

2. (a) Describe the various corrections that are applied to the observed hydrometer readings. How they are determined.
   (b) Liquid limit tests on a given sample of clay were carried out. The data obtained are as given below.

Test no.	1	2	3	4
Water Content (%)	70	64	47	44
Number of Blows, N	5	8	30	45

   Draw the flow curve on semi-log paper and determine the liquid limit and flow index of the soil.

3. (a) How do you determine the permeability of a clayey soil in the laboratory? Derive the formula you use.
   (b) Estimate the quantity of flow of water through a soil mass in a 300 sec period, when a constant head of 1m is maintained. The length of the sample is 150 mm and the cross sectional area is 100×100 mm. The coefficient of permeability of the soil sample is 1×10^{-1} mm/s.

4. (a) Explain the graphical procedure of drawing the phreatic line in a homogeneous earth dam provided with a toe drain.
   (b) A soil profile consists of a surface layer of sand 3 m thick (γ = 16 kN/m^3), an intermediate clay layer 2 m thick (γ_{sat} = 19.50 kN/m^3), and a bottom layer of gravel 4 m thick (γ_{sat} = 19 kN/m^3). The water table is at the top of clay layer. Draw total, effective and neutral pressure diagrams when a surcharge of 50 kN/m^2 acts at the surface.

5. (a) How would you determine the stresses at a point due to
   (i) Strip load (ii) Circular load.
   Compare the zones of influence due to the two types of loads.
   (b) A load of 16 kN/m^2 is uniformly distributed over a circular area of 6m diameter at the ground surface. Calculate the vertical stress at a point, P, which is at a depth of 5m directly below the center of the loaded area.

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6. (a) How to measure the water content of the filed soil with the help of Proctor needle method? Discuss in detail.
   (b) The wet weight of a sample is missing in a proctor test. The oven-dry weight of this sample is 189 N. The volume of the mould used is 1000cm^3. If the degree of saturation of the sample is 90% determine its water content and bulk density?

7. (a) Define:
   (i) Compression index
   (ii) Coefficient of volume decrease
   (iii) Coefficient of consolidation
   (iv) Percent consolidation
   (b) Two clay layers A and B are 5 m and 6 m thick respectively. Time taken by layer A to reach 50% consolidation is 4 months. Calculate the time taken by layer B to reach same degree of consolidation. Layer A has double drainage, while layer B has single drainage. Coefficient of consolidation of layer A is twice that of layer B.

8. (a) What are the advantages and disadvantages of triaxial compression test in comparison with direct shear test
   (b) A specimen of clean dry cohesionless sand is tested in shear box and the soil failed at a shear stress of 40 kN/m^2 when the normal load on the specimen was 50 kN/m^2. Determine (i) the angle of shearing resistance (ii) the principal stress during the failure and (iii) the directions of the principal planes with respect to the direction of the shearing

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1. (a) Write notes on texture and structure of soils.
   (b) A sample of clay soil of volume 1×10^{-3} m^3 and weight 17.62 N, after being dried out in an oven had a weight of 13.68 N. If the specific gravity of the particle was 2.69, find:
   (i) water content, (ii) void ratio, (iii)saturated unit weight, and (iv) dry unit weight.

2. (a) What is plasticity chart? Explain its use in soil classification.
   (b) Determine the times (t) required for particles of diameters 0.2, 0.02, 0.01 and 0.005 mm to fall a depth of 10 cm from the surface in water. Given: $\mu = 8.15 \times 10^{-3}$ gm-sec/cm^2, $G = 2.65$.

3. (a) Derive an expression for determining permeability of soil by falling head permeameter.
   (b) It is observed that in 25 minutes 800 ml of water passes through a soil sample of 15 cm high and 75 cm^2 cross section under a head of 120 cm. Determine the discharge velocity and coefficient of permeability. If on oven drying the sample weighs 0.0135 kN, compute the seepage velocity. Assume the specific gravity of solids as 2.70.

4. (a) Define: total stress, effective stress and neutral stress as applied to soils.
   (b) What are the corrections to be made to the phreatic line? And how the same is carried out?
   (c) What is a flow net? State its properties and applications. What is the quantity of seepage between two successive flow lines and equipotential lines?

5. (a) Discuss the essential differences between Boussinesq's and Westergaard's theories.
   (b) The uniform intensity of loading at the foundation level of a building is 10 m in width and very great extent in length, with the intensity of loading of 100 kN/m^2. Using Boussinesq's analysis, compute analytically the vertical pressure under the centre of footing at a depth of 10 m. Also find vertical stress at a depth of 1m under the edge of the building.

6. (a) Define compaction of soils and list out the various factors that influence the compaction of soils.
   (b) What are the different methods of compaction adopted in the filed? How would you select the type of roller to be used?

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7. (a) Explain in detail any one method for determining the coefficient of consolidation of soil.
   (b) The thickness of a saturated specimen of clay decreases form 20 mm to 15 mm when the effective pressure is increased from 1.2 kg/cm^2 to 2.4 kg/cm^2. If the initial water content is 20%, specific gravity of solids is 2.65 and coefficient of permeability is 5×10^{-5} cm/s, determine the coefficient of compressibility, compression index, coefficient of volume compressibility and coefficient of consolidation.

8. (a) Discuss about different drainage conditions in the case of Triaxial compression tests on soils.
   (b) In a direct shear test on a sandy soil, the normal stress and shear stress at failure are obtained as 100 kN/m^2 and 80 kN/m^2, respectively. Determine the angle of internal friction of the soil and also determine the principal stresses and the orientation of principal planes for the given test data