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**B.E / B.Tech (Full Time) DEGREE END SEMESTER ARREAR EXAMINATIONS, NOV / DEC. 2013**

CIVIL ENGINEERING

Fourth Semester

**CE284 / CE9255 & Soil Mechanics**

(Regulation 2004/2008)

Time : 3 Hours | Answer ALL Questions | Max. Marks 100

**PART-A (10 x 2 = 20 Marks)**

1. Give the grain size ranges of different soil types according to IS: 1498(1970).
2. State whether the following statement is true or false and justify your answer. "The clay core of an earth dam is usually compacted on the wet side of OMC".
3. What are the factors that influence the height of capillary rise in soils?
4. State whether the following statement is true or false and justify your answer. "Darcy's law of flow through soils is valid for flow through gravels and pebbles"
5. To determine the vertical stress in a sedimentary soil deposit, which theory is more appropriate to use – Boussinesq's or Westerguard's theory? Justify your answer.
6. What is the difference between normally consolidated and over consolidated soils?
7. What are the main advantages of triaxial shear test over the direct shear test?
8. Draw a typical stress – strain curves and volume change characteristic curves of clay soil tested during a CD test.
9. List out atleast four typical field examples of slope stability problems in geotechnical engineering.
10. What are the probable types of failure of a slope?

**Part – B ( 5 x 16 = 80 marks)**

11. i) An earthen embankment is compacted to a dry density of 18kN/m$^3$ at moisture content of 13%. The in-situ bulk density and water content in borrow pits are 17kN/m$^3$ and 9% respectively. Find out the maximum quantity of excavation is to be carried out in the borrow pit for construction of each cubic meter of the embankment? (8)

    ii) What do you understand about a plasticity chart? Discuss in details on the use of this chart for classifying fine grained soils. (8)

12. a(i) Falling head permeability test was carried out for the silty sand sample having the cross sectional area of 0.085m$^2$ and the length of 0.112m. During the test, the head was observed to fall from 0.9 m to 0.6 m in 2 minutes. If the cross sectional area of the stand pipe was 0.025 m$^2$, find out the coefficient of permeability of the silty sand. In the same test, if a drop of head was measured from 0.6 m to 0.4 m, determine the time required for the drop of head. (4+4 = 8)

    a(ii) Name the various laboratory methods used for estimating the permeability of soils

and discuss any one method in detail. (2+6 = 8)

**(OR)**

b(i) A drainage pipe beneath a dam has become clogged with sand, coefficient of permeability of the sand is 7.5 m/day. The average difference in head water and tail water elevation is 21 m and it has been observed that there is a flow of 160 litres per day through the pipe. The pipe is 97 m long and has a cross-sectional area of 0.02 $m^2$. Find out up to what length of the pipe is filled with sand? (8)

b(ii) A sheet pile was driven across a river. It retains a head of water of 15 m depth and driven 6.5 m depth below river bed. The soil below the river bed is silty sand and extends up to a depth of 15 m, underlain by an impermeable stratum of clay. Flow net analysis gave $N_f$ = 7 and $N_d$ = 15. The coefficient of permeability of the sub-soil 'k' = 8.0 × $10^{-5}$ m/min. The saturated unit weight of the soil '$\gamma_{sat.}$' = 20 kN/$m^3$. Estimate; (a) The seepage loss per meter length of the pile per day and (b) what is the hydraulic gradient immediately below the trench bed if the average length of the last field is 0.9 m and check for piping if the void ratio of the silty sand is 1.01 and specific gravity is 2.67. (3+5=8)

13. a(i) A monument weighing of 1500 tonnes is considered as concentrated load acting on the ground surface. Assume the soil mass is homogeneous, elastic and isotropic, determine the vertical stress below center of the monument at a depth of 5.0 m from the ground surface and also estimate the vertical stress at the same depth but a distance of 3.0 m away from centre of the monument. (4+4=8)

a(ii) Derive an expression for the critical hydraulic gradient necessary for a 'quick' condition to develop by using (a) a total stress method and (b) effective stress method. (4+4=8)

**(OR)**

b(i) A consolidation test was carried out in the laboratory for a clay soil and observed that a decrease in void ratio from 1.18 to 1.07 for the pressure increased from 25 kN/$m^2$ to 50 kN/$m^2$. Determine the following; (i) the coefficient of compressibility ($a_v$), (ii) the coefficient of volume compressibility ($m_v$) (iii) the coefficient of permeability (k) in m/sec, assume the coefficient of consolidation ($c_v$) was 10 $m^2$/year, and (iv) If the tested clay soil sample was collected from the site having a thickness of 3.5 m, determine the consolidation settlement for the given stress increment. (10)

b(ii) Discuss the Casagrande's logarithm of time fitting method for computing the coefficient of consolidation ($c_v$) (6)

14. a(i) Based on soil exploration, it reveals that a thin layer of silty clay exists at a depth of 15 m from the ground surface. The soil above this level has a dry unit weight of 16 kN/$m^3$ and moisture content of 25 %. The water table is almost near the ground surface. Laboratory test on undisturbed soil samples give the following data: $c_u$ = 40 kN/$m^2$, $\phi$ = 15°, $c_d$ = 34 kN/$m^2$, $\phi_d$ = 23°. Estimate the shearing resistance of the silty clay on a horizontal plane (a) when the shear stress builds up rapidly (Total stress approach), and (b) when the shear stress builds up very slowly (Effective stress approach). (8)

a(ii) How do you estimate the shear strength of clay soil by using unconfined compression tests, discuss. What are its limitations? (8)

**(OR)**

b(i) An earthen embankment is being constructed by using the soil having the following properties obtained from drained test; c′ = 55 kN/$m^2$, $\phi'$ = 20° and $\gamma$ = 16 kN/$m^3$. The pore pressure parameters as determined from the triaxial test are A = 0.45 and B = 0.91. Find the shear strength of soil at base of the embankment just

after the height of fill has been raised from 3.0 m to 6.0 m. Assume that the dissipation of pore pressure during the staged construction is negligible and the lateral confining pressure at any point of time is one-half of the vertical pressure. (8)

b(ii) Name the various methods used for determining the shear strength of soils and discuss any one method in detail. (8)

15. a(i) A natural clay soil slope has an inclination of 35° and height of the slope is 14.0 m with the following properties; $\gamma_t$ = 19 kN/m$^3$, $\gamma'$= 10 kN/m$^3$, $c'$ = 30 kN/m$^2$, $\phi'$ = 30°. Estimate the stability of the slope, when (a) the slope is submerged and (b) there is seepage parallel to the slope. (8)

a(ii) What is stability number? How do you use the stability chart for slope stability analysis? (8)

(OR)

b(i) A railway embankment slope inclined at an angle of 35° is made of sandy clay having cohesion of 35 kN/m$^2$ and angle of internal friction of 25°. The effective stability analysis of the slope gave the following; total normal force = 2000 kN, tangential force = 800 kN and total neutral forces = 250 kN. Find out the factor of safety of the slope, if the slope fails in circular pattern which pass through the toe of an embankment having a central angle of 107° with a radius of 17 m. Also, discuss under what conditions the total stress and effective stress based stability analysis results are used for the design and explain why? (8)

b(ii) Discuss the $\phi_u$ = 0 analysis method for stability of analysis of the finite slope. (8)

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