Reg. No. :

Question Paper Code : 40788

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth Semester
Civil Engineering
CE 6405 : SOIL MECHANICS
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. If the maximum, minimum and natural dry unit weight of sand are 18 kN/m^3 15kN/m^3 and 16.5 kN/m^3, find its relative density.
2. List various field compaction methods along with their suitability.
3. What is quick sand condition ? List the conditions for the occurrence of quick sand condition.
4. Derive the expression for capillary rise in a tube inserted in water.
5. Define overconsolidated, Normally consolidated and under consolidated soils.
6. List the assumptions made in Boussinesq's Analysis of stress distribution.
7. Draw the strength envelopes for fully saturated clay subjected to CD test and fully saturated sand subjected to UU test.
8. Draw typical stress-strain curve for specimens failed by brittle failure and plastic failure.
9. Differentiate the modes of failure of finite and infinite slopes.
10. What is the effect of depth of failure surface on the stability of infinite slope in cohesionless soil ?

PART – B (5×13=65 Marks)

11. a) i) A partially saturated sample of soil has a volume of 60 cc and mass of 92g. The sample is dried in an oven and its dried mass is 73.8g. If the specific gravity of solids be 2.62, find the degree of saturation, water content, void ratio, porosity, bulk unit weight and dry unit weight. (6)

ii) Explain IS soil classification system for classifying coarse grained soil. (7)

(OR)

b) i) Discuss various factors influencing compaction behaviour of soils. (5)

ii) Sandy soil in a borrow pit has unit weight of solids as 26.3 kN/m^3, water content equal to 11% and bulk unit weight equal to 16.4 kN/m^3. How many cubic meter of compacted fill could be constructed of 3500 m^3 of sand excavated from the borrow pit, if the required value of porosity in the compacted fill is 30%. (8)

12. a) i) The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 15m, the soil consists of very fine sand having an average void ratio of 0.7. Above the water table, the sand has an average degree of saturation of 50%. Calculate the effective stress on a horizontal plane at a depth of 10m below the ground surface. Take specific gravity of solids as 2.65. (7)

ii) List various laboratory tests for determination of coefficient of permeability and explain any one method in detail. (6)

(OR)

b) i) A stratum of sandy soil overlies a horizontal bed of impermeable material, the surface of which is also horizontal. In order to determine the in-situ permeability of the soil, a test well was made upto the bottom of the stratum. Two observation boreholes were made at distances of 12 m and 24 m respectively from the test well. Water was pumped out from the well at a rate of 180 litres/minute until the water levels became steady. The height of water in the two boreholes was found to be 4.2 m and 6.3 m respectively above the impermeable bed. Find the coefficient of permeability of the sandy soil. (7)

ii) What is flow net ? Explain in detail various uses of flow net. (6)

13. a) Two footings 6m apart (c/c distance) at the same level carry concentrated loads of 1000 kN and 1500kN respectively. Compute the vertical pressure at the following points :

1) Midway between the footings at a depth of 3m below the footing level.
2) Vertically below the centre of each footing at the same depth of 3m. (13)

(OR)

b) i) A circular area on the surface of an elastic mass of great extent carries a uniformly distributed load of 120 kN/m². The radius of the circle is 3m. Compute the intensity of vertical pressure at a point 5 metres beneath the centre of the circle using Boussinesq's method. (7)

ii) Explain with neat sketch Taylor's $\sqrt{t}$ method for the determination of coefficient of consolidation. (6)

14. a) Two identical specimens of a soil were tested in a triaxial apparatus. The first specimen failed at a deviator stress of 770 kPa when the cell pressure was 200 kPa, while the second specimen failed at a deviator stress on 1370 kPa under a cell pressure of 400 kPa. Determine the shear strength parameters. Also, find the deviator stress at failure when the cell pressure was 600 kPa. If the same soil is tested in a direct shear apparatus, estimate the shear stress at which the sample will fail under a normal stress of 600 kPa. (13)

(OR)

b) Samples of compacted, clean, dry sand were tested in a shear box, 6cm× 6cm, and the following observations were recorded :

Normal load (N)	100	200	300
Peak shear load (N)	90	180	270
Ultimate shear load (N)	75	150	225

Determine the angle of shearing resistance in
a) the dense state and in
b) the loose state. (13)

15. a) A new canal is excavated to a depth of 5m with banks having 1 : 1 slope. The properties of the soil are : cohesion = 14 kPa, angle of internal friction = 20°, void ratio = 0.65 and specific gravity of solids = 2.70. Calculate the factor of safety with respect to cohesion when the canal is running full. What will be the factor of safety if the slope is changed to be 30° to vertical ? The Taylor's stability number is given in the table for different slope angles for angle of internal friction = 20°.

Slope angle	30°	45°	60°	75°	90°
Stability number	0.025	0.062	0.097	0.134	0.182

(13)

(OR)

b) i) An infinite slope made of soil with c' = 20 kPa, ϕ= 20°, e = 0.65 and G = 2.7 is 10m high. The slope angle is 25°. Find the factor of safety with respect to height for the following conditions (1) when the soil is dry (2) when the slope is submerged. (6)

ii) Discuss the stability analysis of slopes by method of slices for c - ϕ soil. (7)

PART – C (1×15=15 Marks)

16. a) Subsurface exploration at the site of a proposed building reveals the existance of 2.4 m thick layer of soft clay below a stratum of coarse sand which is 4m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5m below the ground surface. Laboratory tests indicate the natural water content of the clay as 40%, average liquid limit as 45% and specific gravity of solids as 2.75. The unit weight of the sand above and below water table is 17.8 kN/m^3 and 21 kN/m^3 respectively. Estimate the probable settlement of the building, if its construction will increase average vertical pressure on the clay layer by 71 kPa.

OR

b) An embankment consists of clay fill for which $c' = 25$ kN/m^2 and $\phi' = 27°$ (from consolidated undrained tests with pore-pressure measurement). The average bulk unit weight of the fill is 20 kN/m^3. Estimate the shear-strength of the material on a horizontal plane at a point 20 m below the surface of the embankment, if the pore pressure at this point is 180 kN/m^2 as shown by a piezometer.

IV CIVIL 2013