(vii) The shape factors for circular footing, $s_c$, $s_q$, $s_\gamma$ are respectively (IS code)
(a) 1.3, 1.2, 0.8 (b) 1.2, 1.2, 0.8
(c) 1.3, 1.2, 0.6 (d) 1.3, 1.2, 0.4.

(viii) The best method of compaction of sand is by using a
(a) Sheeps- foot roller (b) Vibrator
(c) Pneumatic-tyred roller (d) Power roller.

(ix) Consolidation
(a) is a function of total stress
(b) is a function of effective stress
(c) is a function of neutral stress
(d) does not depend upon the present stress.

(x) Two footing, one circular and other square, are founded in a pure clay. The diameter of the circular footing is the same as the side of the square footing. The ratio of their net ultimate bearing capacities
(a) is unity
(b) is 1.3
(c) is 1/1.3
(d) cannot be determined with the provided data.

## Group – B

2. (a) A stratum of clay 8 m deep, has $w_l$ = 45 % . the surface of clay is at 10 m below the present ground level, w= 40 % and G = 2.78 for clay. Between ground surface and clay, the subsoil consists of fine sand. The ground water level is 4.5 m below ground level. The average submerged unit weight of sand is 10.4 kN/m$^3$ and the unit weight of sand above the ground water level is 17 kN/m$^3$ . The clay is normally consolidated. The weight of structure coming on top of the sand above the clay increases the overburden pressure on clay by 40 kN/m$^2$. Estimate the consolidation settlement of the building.

(b) The time to reach 40% consolidation of two way laboratory 10 mm thick saturated clayey soil sample is 35 seconds. Determine the time required for 60% consolidation of the same soil 10 m thick on the top of a rocky surface subjected to the same loading conditions as the laboratory sample.

(c) Write short notes on the following:
(i) Standard Proctor and modified Proctor test.

**6 + 4 + 2 = 12**





9. (a) What will be the factors of safety w.r.t. average shearing streng which the strength parameters obtained from the laboratory tests a 32 kN/m$^2$, $\phi$ = 18°; the expected parameters of mobilized sh resistance are $c'_m$ = 21 kN/m$^2$ and $\phi_m$ = 13° and the average ef pressure on the failure surface is 110 kN/m$^2$. For the same value mobilized shearing resistance determine the following: FOS w.r.t. l FOS w.r.t. friction when that w.r.t. cohesion is unity and FOS w.r.t. str

(b) It is required to make a 6m deep excavation in a stratum of so having $c$ = 26 kN/m$^2$, $\gamma$ = 18 kN/m$^3$. A rock layer exists at a depth below the ground level. Determine the factor of safety of the slope a sliding and the distance at which the critical circle cut the ground s away from the toe if the slope angle of 40°. [Given: $S_n$ = 0.172 and $n_x$ =

(c) A canal having side slopes 1:1 is proposed to be constructe cohesive soil to a depth of 5m below ground surface. The soil prop are : $c_u$ = 12 kN/m$^2$; $\phi_u$ = 15°; $e$ = 1.0; $G$ = 2.65. Find the FOS cohesion against failure of the bank slopes when (i) the canal is water and (ii) there is a sudden drawdown of water in the canal. [ for $\beta$= 45°, $\phi_u = 15°$, $N_s$ = 0.08 & for $\beta$= 45°, $\phi = 6.8°$, $N_s$ = 0.126

(d) Compute the consolidation settlement for the problem sho figure5, by Skempton and Bjerrum method. The compressible of depth 16m is divided into four layers. The net pressur transmitted by the foundation is 100 kN/m$^2$. [Given: $\beta$ = 0.8].

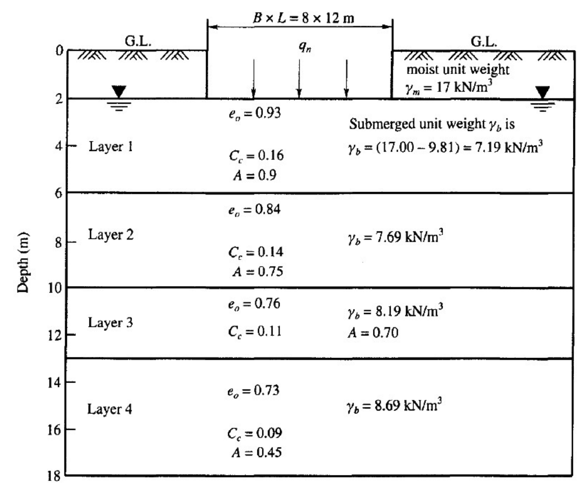

Figure 5

**4 + 2 + 2+ 4**

**B.TECH/CE/5TH SEM/CIVL 3102/2016**

**SOIL MECHANICS II**
**(CIVL 3102)**

**Time Allotted : 3 hrs** **Full Marks : 70**

***Figures out of the right margin indicate full marks.***

***Candidates are required to answer Group A and***
***<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.***

***Candidates are required to give answer in their own words as far as practicable.***

**Group – A**
**(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The FOS of a slope of infinite extent having a slope angle = 25° and made of cohesionless soil with $\phi$ = 36° is given by
(a) 1.558 (b) 1.254 (c) 0.892 (d) 1.325.

(ii) The approximate maximum depth of an unsupported vertical cut that can be made in a saturated clay with $\gamma$ = 19 kN/m$^3$ and an unconfined compressive strength of 80 kN/m$^2$ is given by
(a) 2.5m (b) 8.4m (c) 10.2m (d) 3.5m.

(iii) The predominant settlement in sand is
(a) immediate settlement (b) consolidation settlement
(c) both (a) and (b) (d) plastice settlement.

(iv) At-rest earth pressure coefficient for a soil with friction angle 30° is
(a) 0.3 (b) 0.4 (c) 0.5 (d) 0.6.

(v) Increase in compaction effort causes
(a) increase in OMC and decrease in dry unit weight
(b) increase in both OMC and dry unit weight
(c) decrease in OMC and increase in dry unit weight
(d) decrease in both OMC and dry unit weight.

(vi) A clay deposits suffers a total settlement of 5 cm with one-way drainage. With two-way drainage, total settlement will be
(a) 10 cm (b) 2.5 cm (c) 20 cm (d) 5 cm.

## Group – E

8. (a) A footing 4m × 2m in plan transmits a pressure of 150 kN/m² on a cohesive soil having modulus of elasticity as 6 × 10⁴ kN/m² and Poisson's ratio as 0.5. Determine the immediate settlement of the footing at the centre assuming it to be (i) flexible, (ii) rigid and (iii) using the rigidity factor as recommended by IS code for case (i).[Given: $I_f$ = 1.53 and 1.20 for flexible and rigid footings, respectively]. Take depth correction factor as 1.0.

(b) What are the different types of settlement?

(c) Determine by Culmann's method the critical height of an embankment having a slope angle of 40° and the constructed soil having $c'$ = 30.2 kN/m², $\phi'$ = 20°, and effective unit weight = 18 kN/m³. Find the allowable height of the embankment if $F_c = F_\phi$ = 1.25.

(d) As shown in figure 4, the cross-section of a cutting in a homogeneous, saturated clay soil inclined at a slope of 2(H):1(V), with a height of 8 m. Bulk unit weight of the soil is 18 kN/m³ and undrained unit cohesion is 27 kN/m² ($\phi_u$ = 0). Determine the factor of safety against immediate shear failure along the slip circle as shown in the figure 4 under the following conditions (i) ignoring tension crack, (ii) allowing for the tension crack but without water and (iii) allowing for the tension crack filled with water. [Given: Area of the sliding mass and its centroid distance from O are 108.5m² and 3.6 m, respectively, when the arc length is AD].

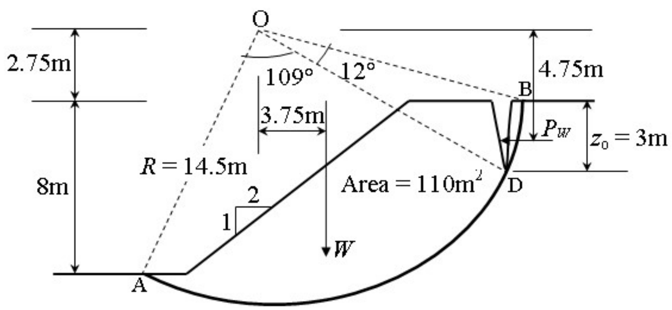


Figure 4

(e) Briefly describe different types of failure in slope stability analysis.

**3 + 1 + 3 + 3 + 2 = 12**





3. (a) Following are the results of a compaction test:

| No. of test | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Weight of the mould + wet soil (kg) | 3.526 | 3.711 | 3.797 | 3.906 | 3.924 | 3. |
| Water content (%) | 8.33 | 10.40 | 12.23 | 16.20 | 17.92 | 2( |

The mould is 12.7 cm high and has an internal diameter of 10 c
The weight of the empty mould is 1.89 kg.
Specific gravity of solids = 2.68.
(i) Plot the compaction curve showing the optimum mo content and maximum dry density.
(ii) Plot the zero air voids line and 10% air void curve.

(b) Write short notes on:
Determination of coefficient of consolidation (any one method)

**7 + 5**

## Group – C

4. (a) A retaining wall with a smooth vertical backface has to retain a backfill upto a height of 4.5m. A uniform surcharge of 5 t/ placed over the backfill. The water table is located at 2m belo The backfill properties are : $\phi$ = 30°, $e$ = 0.82, $G$ = 2.68. The soil the water table has a degree of saturation of 10%. Determi magnitude and point of application (above the base of the w the resultant active thrust on the wall.

(b) A retaining wall with a smooth vertical backface has to retain a b of c - ϕ soil upto a height of 5m. The surface of the backfill ($\gamma$ = 1.8 t = 1.5 t/m² and $\phi$ = 12°) is horizontal. (i) Determine the depth of z tension cracks, (ii) Plot the distribution of active earth pressure wall, (iii) Determine the magnitude and point of application resultant active thrust on the wall, (iv) Determine the intensit fictitious uniform surcharge, which, if placed over the backfi prevent the formation of tension cracks, (v) Compute the res active thrust on the wall after placing the surcharge.

(c) A rigid retaining wall of 6m height has two layers of backfill. T layer to a depth of 1.5m is sandy clay having $c$ = 12.15 kN/m², $\phi$ and $\gamma$ = 16.4 kN/m³. The bottom layer is sand having $c$ = 0, $\phi$ and $\gamma$ = 17.25 kN/m³. Determine the total active thrust acting wall and its location above the base of the wall.

**4 + 5 + 3**

5. (a) A retaining wall of 4.5m height has to retain a stratified backfill as shown in figure 1. Determine the magnitude of total active thrust on the wall and locate its point of application above the base of the wall.

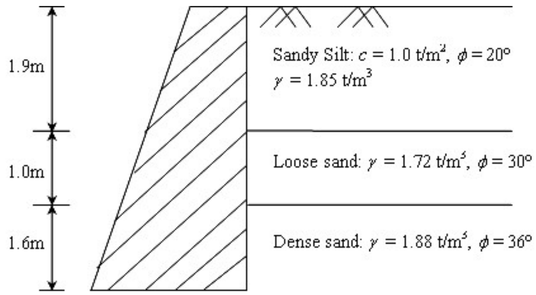


Figure 1

(b) A section of a cantilever wall with dimensions is shown in figure 2. Check the stability of the wall with respect to overturning, sliding and bearing capacity if the ultimate bearing capacity of the foundation soil is 600 kN/m². [Given: angle of friction ($\delta$) and adhesion ($c_a$) between base slab and foundation soil are 25° and 33 kN/m², respectively].

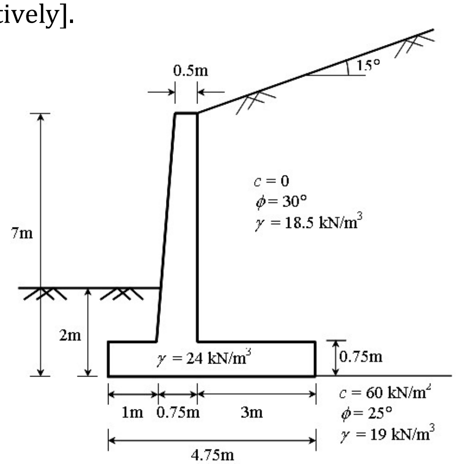


Figure 2

**5 + 7 = 12**

**Group – D**

6. (a) Write down the assumptions made by Terzaghi for computing ultimate bearing capacity of soil below footing.





(b) A strip footing 2 m wide carries a load intensity of 400 kN/m depth of 1.2 m in sand. The saturated unit weight of sand is 19. kN/m³ and unit weight above water table is 16.8 kN/m³. The strength parameters are c = 0 , $\phi$ =35˚. Determine the factor of with respect to shear failure for the following cases of locat water table:

(i) Water table is 4 m below G.L.
(ii) Water table is 1.2 m below G.L.
(iii) Water table is 2.5 m below G.L.
(iv) Water table is 0.5 m below G.L.
(v) Water table is at G.L. itself. Use Terzaghi equations.

**(2) + (5 × 2**

7. (a) A water tank foundation has a footing of size 6 m × 8 m, founde depth of 3 m below ground level in a medium dense sand strat great depth. The saturated unit weight of the soil is 20 kN/n unit weight above water table is 18 kN/m³. The foundat subjected to a vertical load at an eccentricity of B/10 along the axes. Figure 3 gives the soil profile with the remaining Estimate the ultimate load, $Q_{ult}$ , IS method. Consider general failure. For $\phi$ =35˚, $N_c$ = 46.12, $N_q$ = 33.30 and $N_\gamma$ = 48.03. factors are: $s_c = s_q$= 1+0.2(B/L) $s_\gamma$ = 1-0.4 (B/L) and depth facto 1+ 0.2×$\sqrt{N_\phi}$ × ($D_f$ /B), $d_q = d_\gamma$ = 1+ 0.1×$\sqrt{N_\phi}$ × ($D_f$ /B) where, $N_\phi$ (45+$\phi$/2) and inclination factor, $i_q$ = (1-α/90)² and $i_\gamma$ = (1-α/ $\phi$)

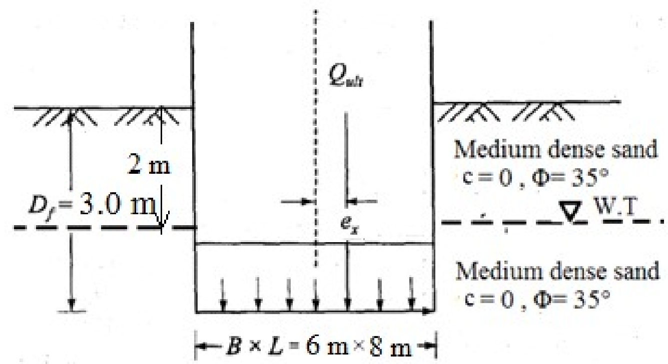


Figure 3

(b) Explain with neat sketches, the different modes of failure i under a foundation load.

**9 + 3**