CS/B.TECH(CE)(N)/SEM-5/CE-501/2012-13

2012

FOUNDATION ENGINEERING

Time Allotted : 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

    i)   An infinite slope is inclined at an angle I and has its angle of internal friction φ, the stability number S_n is

    a) $\cos^2 i/(\tan i - \tan \varphi)$ b) $\sin^2 i/(\tan i - \tan \varphi)$

    c) $(\tan i - \tan \varphi) \cos^2 i$ d) $(\tan i - \tan \varphi) \sin^2 \varphi.$

    ii) Depth of tensile zone near the surface of a cohesive fill is

    a) $(c / \gamma) / N \phi$ b) $(\gamma/c) / N \phi$

    c) $(2c / \gamma) / N \phi$ d) $(2c / \gamma) / (1/N \phi).$

    iii) Taylor's stability number is equal to

    a) $C/F_C H$ b) $C/FC\gamma H_C$

    c) $C/\gamma H$ d) $C/\gamma H_C.$

    Where, C = unit cohesion

    F_C = factor of safety with respect to cohesion

    γ = unit weight of soil

    H_C = critical height

    H = actual height

iv) The structure which derives its stability due to self weight is

    a)   sheet pile wall

    b)   bulk head

    c)   cantilever retaining wall

    d)   masonry retaining wall.

v) Coefficient of earth pressure at rest is

    a)   less than active earth pressure but greater than passive earth pressure

    b)   greater than active earth pressure but less than passive earth pressure

    c)   greater than both active and passive earth pressure

    d)   less than both active and passive earth pressure.

vi) Undisturbed soil samples are best colleted by

    a)   thin walled samplers   b)   thick walled samplers

    c)   direct excavation   d)   auger.

vii) For soil sample to be undisturbed, the area ratio should be

    a)   less then 20% in stiff formation and 10 % in soft clay

    b)   less than 10% in stiff formation and 20 % in soft clay

    c)   less than 20% in each case

    d)   less than 10% in each case.
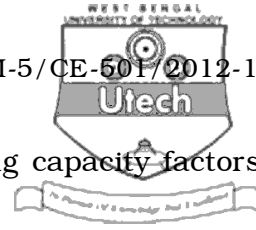
viii) In pure clayey soil, Terzaghi's bearing capacity factors, Nc, Nq, Ny respectively are

a) 5·7, 1·0, 0·0

b) 0·0, 1·0, 5·7

c) 0·0, 5·7, 1·0

d) 1·0, 0·0, 5·7

ix) Rise of water table in cohesionless soil up to ground surface reduces the net ultimate bearing capacity by

a) 25 %

b) 50 %

c) 75 %

d) 90 %.

x) A shallow foundation is 2 m deep having water table at a depth of 1 m from ground surface. Unit weights of soil above and below the water table are 16 and 18 kN/m^3 and that of water is 9·81 kN/m^3. The effective surcharge at the base level of foundation is

a) 24·19 kN/m^2

b) 24 kN/m^2

c) 25·5 kN/m^2

d) none of these.

xi) The maximum differential settlement in isolated footings on clayey soils should be limited to

a) 25 mm

b) 40 mm

c) 65 mm

d) 100 mm.

xii) Negative skin friction of a pile,

    a) acts downward and increases the load carrying capacity of the pile

    b) acts upward and increases the load carrying capacity of the pile

    c) acts downward and reduces the load carrying of the pile

   d) acts upward and reduces the load carrying capacity of the pile.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is earth pressure at rest ? Explain the concept of active and passive earth pressure for granular soils with the help of Mohr Circle and Shear Strength Envelop.

3. An excavation is to be made in a soil deposit with a slope of 25° to the horizontal and to a depth of 25 m. The soil has the following properties :

$C' = 35$ kN/m^2, $\theta = 15°$ and $\gamma = 20$ kN/m^3 :

   a) Determine the F.S. of the slope assuming full friction is mobilized
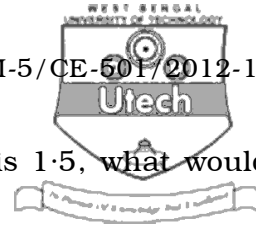
b) If the F.S. with respect to cohesion is 1·5, what would be the F.S with respect to friction ?

Given, for $\theta = 15°$ and $i = 25°$, $S_n = 0·03$, for $S_n = 0·047$ and $i = 25°$, $\theta_m = 13°$.

4. In a 16 pile group, the pile diameter is 60 cm and centre to centre spacing of the square group is 1·8 m. If $C = 50$ kN/m^2, determine whether the failure would occur with the pile acting, individually or a group. Neglect bearing at the tip of the pile. All are 15 m long. Take degree of mobilisation of shear, $m = 0·7$.

5. A square foundation is 1·5 m × 1·5 m in plan. Corresponding to the friction angle of soil supporting the foundation, Nc, Nq and $N\gamma m$ are respectively 17·7, 7·4 and 5·0 and $C = 15·2$ kN/m^2. The unit weight of soil γ is 17·8 kN/m^3. Determine the allowable gross load on the foundation with a factor of safety of 4. The depth of foundation is 1·0 m and general shear failure occurs in soil.

6. Explain the terms 'elastic settlement', 'consolidated settlement', 'friction piles', 'end bearing piles'., 'Tension cracks'.
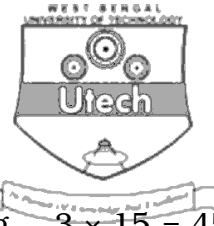
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

7. What are the assumptions made to analysis an anchored sheet pile structure under free earth method of analysis ? Derive the expression of depth of embedment of an anchored sheet pile structure when driven into a cohesive soil. Find the embedded depth of the cantilever sheet pile as given in following figure :
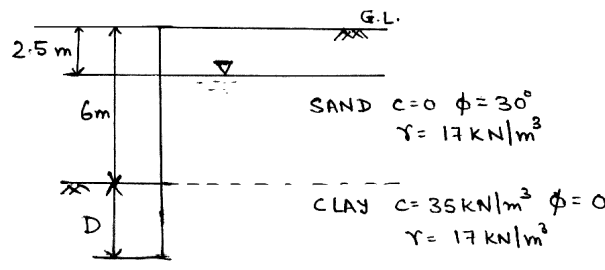
8. For the cantilever retaining wall shown below, determine the maximum and minimum pressure under the base of the cantilever. The relevant shear strength parameters of the backfill and foundation soil are c = 0, ϕ = 35°, unit weight of soil γ = 17·5 kN/m^3 . The unit weight of wall material is 23·5 kN/m^3. Find also the factor of safety against sliding and overturning considering the reduced value of base friction as (2/3) ϕ.
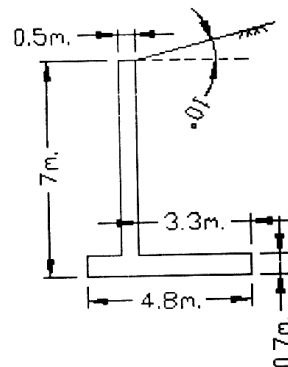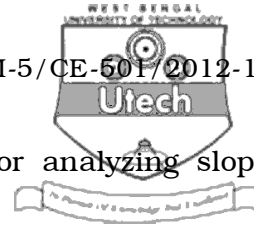
9. a) Explain the friction circle method for analyzing slope stability.

b) A slope is to be constructed in a soil for which $\overline{C} = 0$ and $\overline{\theta} = 36°$. It is to be assumed that the water may occasionally reach the surface of a slope with seepage taking place parallel to the slope. Determine the maximum slope angle for F.S. = 1·5, assuming a potential failures surface parallel to the slope. What would be the F.S of the slope constructed at this angle, if the water table should be well below the surface ? Take γ_{sat} = 19 kN/m^3. 9 + 6

10. Calculate the net ultimate bearing capacity of a rectangular footing 1·8 m × 3·6 m in plan founded at a depth of 1·6 m below the ground surface. The load on the footing acts at an angle of 16° to the vertical and is eccentric in the direction of width by 15 cm. The unit weight of the soil is 18 kN/m^3. Natural water table is a depth of 2 m below the ground surface $c^{'}$ = 15 kN/m^3, $\theta^{'}$ =30°, Nc = 30·10, Nq = 18·38 and Nr = 22·4.
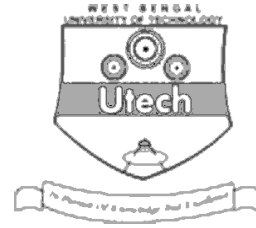
11. a) How pile capacities are estimated by

    (i) Static and

    (ii) Dynamic formulae as per IS code recommendations in clayey soils ?

   b) Using Hiley's formula, determine the safe pile load, with the following data : Weight of hammer = 30 kN, Weight of pile = 18 kN, Average set under last 6 blows = 12·5 mm, Hammer stroke = 0·91 m, Hammer efficiency = 70 p.c. constants : $k1$ = 6 mm, $k2$ = QL/(AE), $k3$ = 2·5 mm, Pile length = 10 m, Pile diameter = 300 mm.   4 + 4 + 7