

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (CE)/SEM-7/CE-703/2010-11
2010-11
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) The standard penetration resistance value N (blows/30 cm) for general shear failure of bearing capacity is
- a) between 10 and 20
 - b) between 20 and 25
 - c) greater than/equal to 30
 - d) less than 30.
- ii) The net ultimate bearing capacity on fairly saturated homogeneous cohesive soils is equal to (as per IS code)
- a) $c.N_c^I.s_c.d_c.i_c$
 - b) $c.N_c^I.S_c.d_c.i_c + \bar{\sigma}(N_q^I - 1).s_q.d_q.i_q$
 - c) $c.N_c^I.S_c.d_c.i_c + \bar{\sigma}(N_q^I - 1).s_q.d_q.i_q + 0.5 \gamma B.N_\gamma^I.s_\gamma.d_\gamma.i_\gamma$
 - d) $5.14 c.s_c.d_c.i_c$.



iii) The depth of foundation is D ; the water table is at $D/2$ from the G.L; the γ -average of the surcharge soil in bearing capacity equation is

- a) $\gamma_{\text{sat}} - \gamma_w$
- b) $\gamma - \gamma_w$
- c) $\frac{1}{2}(\gamma - \gamma_{\text{sat}})$
- d) none of (a) (b) or (c).

iv) Shape factors as per IS 6403-1981 for square footing s_c , s_q , s_γ are respectively

- a) 1.3, 1.2, 0.8
- b) 1.2, 1.2, 0.8
- c) 1.3, 1.2, 0.6
- d) 1.2, 1.3, 0.6.

v) A shallow foundation is 2 m deep having water table at a depth of 1 m from ground surface. Unit weight 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.

vi) The safe load Q_{st} on pile should not exceed

- a) $Q_{\text{st}} = (0.25 f_{\text{CK}}) \cdot A_c$
- b) $Q_{\text{st}} = (0.33 f_{\text{CK}}) \cdot A_c$
- c) $Q_{\text{st}} = (0.40 f_{\text{CK}}) \cdot A_c$
- d) $Q_{\text{st}} = (0.50 f_{\text{CK}}) \cdot A_c$.

where f_{CK} is the characteristic strength of concrete and A_c is cross-sectional area of pile.



vii) In a foundation of size 2 m × 4 m, the load is eccentric by 0.15 m in both the axes. The effective size of the foundation is

- a) 1.7 m × 3.7 m b) 1.85 m × 3.85 m
c) 2.15 m × 3.85 m d) 1.85 m × 4.15 m.

viii) The size of a foundation is 2 m × 4 m. The depth of foundation is 1.5 m. The shape factor, s_c is equal to

- a) 1.1 b) 1.0
c) 1.85 d) none of these.

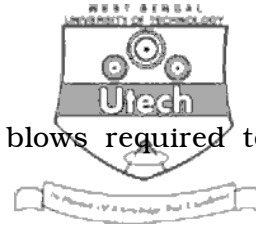
ix) Inclination factor due to load inclined at α° with the vertical is

- a) $i_c = 1 - \frac{\alpha}{90}$ b) $i_c = \left(1 - \frac{\alpha}{90}\right)^2$
c) $i_c = \left(1 - \frac{\alpha}{\Phi}\right)^2$ d) $i_c = 1 - \frac{\alpha}{\Phi}$.

where Φ is angle of shearing resistance.

x) In general shear failure of soil underneath shallow foundation, the soil wedge immediately beneath the footing is the zone of

- a) Rankine's passive state
b) Radial shear state
c) Elastic equilibrium
d) None of these.



xi) The SPT-N value is the number of blows required to drive the sampler through the last

- a) 15 cm b) 30 cm
- c) 45 cm d) 50 cm.

xii) The type of sampler used in standard penetration test is

- a) Shelby tube sampler b) piston sampler
- c) split-spoon sampler d) any of these.

xiii) The depth of well foundation from the high flood level is at least

- a) 1.33 times the deepest scour depth
- b) 1.20 times the deepest scour depth
- c) 1.25 times the deepest scour depth
- d) 1.30 times the deepest scour depth.

xiv) For spread footings on sand the maximum allowable angular distortion is

- a) 1/100 b) 1/150
- c) 1/200 d) 1/300.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Write down the points required for soil report writing. What are the functions of Geotextiles ?
3. What is the difference between bouancy raft and conventional raft ? Differentiate between local shear failure & punching shear failure.
4. What are the different types of settlement that a shallow foundation can undergo ?
5. Give neat sketch of a well foundation showing the various components.
6. Describe Chunk sample.

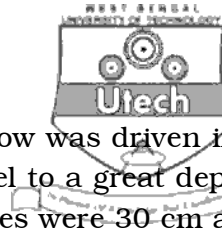
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

7. Describe with neat sketches how the depth of exploration and lateral extent of exploration for different kind of foundations considered and finalised for execution. 10 + 5
8. Discuss standard penetration test. What are the various corrections ? What is the importance of the test in geotechnical engineering ? 6 + 6 + 3
9. a) State the limitation of Terzaghi's theory in predicting the bearing capacity of a shallow foundation footing on a cohesive deposit.
b) A footing of 2 m square is laid at a depth of 1.3 m below the ground surface. Determine net ultimate bearing capacity using IS code method. Given $\gamma = 20 \text{ kN/m}^3$, $\phi' = 20^\circ$, $c' = 0$, $N_c = 30.14$, $N_q = 18.14$, $N_\gamma = 22.40$, $S_c = 1.3$, $S_q = 1.2$ and $S_\gamma = 0.80$. 5 + 10



10. a) A group of 16 piles with 4 piles in a row was driven into a soft clay extending from ground level to a great depth. The diameter and the length of the piles were 30 cm and 12 m respectively. The unconfined compressive strength of the clay is 70 kN/m^2 . The piles were placed at 90 cm centre to centre. Compute the allowable load on the pile group on the basis of a shear failure criterion for a factor of safety of 2.5 for the following conditions :

- i) block failure and
- ii) individual pile failure.

$$(N_c = 9, \alpha = 1, c = 70/2 = 35 \text{ kN/m}^2)$$

- b) If the above pile group passes through a recently constructed fill cohesive soil of depth $L_n = 3 \text{ m}$, $q_n = 60 \text{ kN/m}^2$ and $\gamma = 16 \text{ kN/m}^3$, compute the negative frictional load on the pile group. $C_u = 60/2 = 30 \text{ kN/m}^2$.

10 + 5

11. a) A concrete pile 30 cm diameter is driven into a medium dense sand ($\phi = 35^\circ$, $N_q = 60$, $D_c/B = 12$, $\gamma = 21 \text{ kN/m}^3$, $K = 1.0$, $\tan \delta = 0.70$) for a depth of 8 m. Estimate the safe load, taking a factor of safety of 2.50.

- b) A square footing of width 2.2 m is to be constructed in a homogeneous sand stratum at 1.0 m below GL. The water table is located at a great depth. The properties of the sand are as follows :

$$\phi = 35^\circ, c = 0, \gamma = 18 \text{ kN/m}^3$$

Determine the ultimate, net ultimate, net safe and safe bearing capacities of the footing. Assume a general shear failure. The factor of safety against shear failure may be taken as 3. Terzaghi's bearing capacity factors for $\phi = 35^\circ$ are

$$N_c = 57.8, N_q = 41.4, N_\gamma = 42.4.$$

15



12. a) Discuss the effects of submergence on the bearing capacity of a shallow foundation.
- b) A strip footing of width 2.0 m is to be founded at a depth of 1.2 m below GL in a loose sand deposit having the following properties :

$$\phi = 25^\circ, c = 0, \gamma = 17.8 \text{ kN/m}^3$$

The water table is at a substantial depth below GL.

- i) Determine the ultimate and safe bearing capacities of the footing, with respect to a factor of safety of 3, using Terzaghi's bearing capacity equation.
- ii) Determine the percent change in the ultimate bearing capacity if the water table rises up to the base of the foundation. Given $\gamma_{\text{sat}} = 18.13 \text{ kN/m}^3$.

$$\text{For } \phi = 25^\circ, N_q = 12.7, N_c = 25.10, N_\gamma = 9.7, \\ N_c = 14.8, N_q = 5.6, N_\gamma = 3.2. \quad 5 + 10$$

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