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) $c.N'_c.s_c.d_c.i_c$

b) $c.N'_c.S_c.d_c.i_c + \bar{\sigma}(N'_q - 1).s_q.d_q.i_q$

c) $c.N'_c.S_c.d_c.i_c + \bar{\sigma}(N'_q - 1).s_q.d_q.i_q + 0{\cdot}5\ \gamma B.N'_\gamma.s_\gamma.d_\gamma.i_\gamma$

d) $5{\cdot}14\ c.s_c.d_c.i_c$.

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) $\gamma_{sat} - \gamma_w$

b) $\gamma - \gamma_w$

c) $\frac{1}{2}(\gamma - \gamma_{sat})$

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 form 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) $Q_{st} = (0 \cdot 25\ f_{CK}).\ A_C$ b) $Q_{st} = (0 \cdot 33\ f_{CK}).\ A_C$

c) $Q_{st} = (0 \cdot 40\ f_{CK}).\ A_C$ d) $Q_{st} = (0 \cdot 50\ f_{CK}).\ A_C$.

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^0 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 $\gamma = 20\ kN/m^3$, $\phi' = 20^\circ$, $c' = 0$, $N_c = 30{\cdot}14$, $N_q = 18{\cdot}14$, $N_\gamma = 22{\cdot}40$, $S_c = 1{\cdot}3$, $S_q = 1{\cdot}2$ and $S_\gamma = 0{\cdot}80$. 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.

($N_c = 9$, $\alpha = 1$, $c = 70/2 = 35$ KN/m^2)

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

10 + 5

11. a) A concrete pile 30 cm diameter is driven into a medium dense sand ($\phi = 35°$, $N_q = 60$, $D_c/B = 12$, $\gamma = 21$ 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 :

$\phi = 35°$, $c = 0$, $\gamma = 18$ 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. Terzahgi's bearing capacity factors for $\phi = 35°$ 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, $\gamma = 17{\cdot}8\ kN/m^3$

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 $\gamma_{sat} = 18{\cdot}13\ kN/m^3$.

For $\phi = 25^\circ$, $N_q = 12{\cdot}7$, $N_c = 25{\cdot}10$, $N_\gamma = 9{\cdot}7$, $N_c = 14{\cdot}8$, $N_q = 5{\cdot}6$, $N_\gamma = 3{\cdot}2$. 5 + 10