

Name :

Roll No. :

Invigilator's Signature :

**CS/M.TECH (GET)/SEM-1/GTE-103/2012-13
2012**

ADVANCED FOUNDATION ENGINEERING-I

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.*

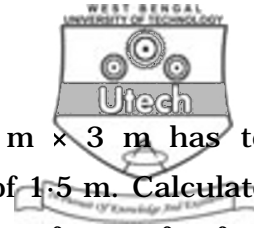
[Use of I.S. Codes 2950 & 2911 is permitted]

Answer any five questions : 5 × 14 = 70

1. Determine the ultimate and the net safe bearing capacity of the rectangular footing using I.S. Code method. The length of footing is 3 m and the breadth is 2 m. The depth of foundation is 1 m. The average density of the cohesionless soil near the surface is 1.6 T/m^3 and the average density below the base of the footing is 1.9 T/m^3 . The N values obtained at different depth in the field are given in the following table :

Depth (m) :	0.75	1.5	2.25	3.0	3.75	4.50	5.25	6.0
N Value :	8	10	13	16	15	17	20	23

Given for $N = 14$, $\varphi = 31^\circ$ and for $\varphi = 31^\circ$, $N_q = 14.5$ and $N_\gamma = 17$.



2. A rectangular footing has a size of 1.8 m × 3 m has to transmit the load of a column at a depth of 1.5 m. Calculate the safe load which the footing can carry at a factor of safety of 3 against shear failure. Use IS code method. The soil has following properties : $n = 40\%$, $G = 2.67$, $w = 15\%$, $c = 8 \text{ kN/m}^2$, $\varphi = 32^\circ$. For $\varphi = 32^\circ$, $N_c = 35.49$, $N_q = 23.18$ and $N_\gamma = 30.22$.

What will be the per cent reduction in the load capacity of the footing, if the water table rises upto (a) base of footing, (b) 1 m below the base of the footing ? Assume that saturated unit weight of soil is 19.5 kN/m^2 .

3. a) Discuss the different causes for differential settlement.
b) What are the corrections made on settlement due to consolidation ?
c) Discuss the methods that can be used to reduce settlement in buildings.
4. a) A load of 4000 kN is being taken by a square column footing. Side of the column is 3 m, footing rests on a silty soil with a Poisson's ratio = 0.25. Modulus of elasticity of the soil was determined by stressing a sample to 300 kPa. The strain noted is 0.6%. Find the settlement at the centre and at edge of the footing. Assume influence factor for centre = 1.12 and at edge = 0.56.
b) What are the different types of settlement that a shallow foundation can undergo ?



5. a) Discuss the relation between SPT values and ϕ with compactness and relative density of sand.
- b) Discuss standard penetration test. What are the various corrections ? What is the importance of the test in geotechnical engineering ?
6. a) Determine the net ultimate bearing capacity of a mat foundation measuring 15 m \times 10 m on a saturated clay with $c_u = 95 \text{ kN/m}^2$, $\phi = 0$, and $D_f = 2\text{m}$.
- b) Estimate the consolidation settlement at the centre of a raft foundation of 30 m \times 40 m plan having total dead load + live load = 200 MN. Consider the data given :

Depth of foundation = 2 m

Ground w.T. = 4 m from G.L.

1st layer (sand) (G.L. — 4 m) : $\gamma = 15.7 \text{ kN/m}^3$

2nd layer (sand) (4 m — 17 m) : $\gamma_{sat} = 19.1 \text{ kN/m}^3$

3rd layer (Normally Consolidated Clay) (17 m — 23 m) :

$\gamma_{sat} = 18.6 \text{ kN/m}^3$, $C_c = 0.28$, $e_o = 0.9$.

4 + 10



7. a) Estimate the consolidation settlement of a $1 \text{ m} \times 2 \text{ m}$ foundation with the help of data given :

Depth of foundation = 1 m

Ground W.T. = 2.5 m from G.L.

$$q_0 = 150 \text{ kN/m}^2$$

1st layer (sand) (G.L. — 2.5 m) : $\gamma = 16 \text{ kN/m}^3$

2nd layer (sand) (2.5 m — 3 m) : $\gamma_{sat} = 17.5 \text{ kN/m}^3$

3rd layer (Normally Consolidated Clay) (3 m — 5.5 m) :
 $\gamma = 16 \text{ kN/m}^3$, $e_a = 0.8$, $E_s = 6000 \text{ kN/m}^2$,

$$C_c = 0.32, \mu_s = 0.5, C_c = 0.09.$$

- b) Combined footing 5.7 m long and 2.4 m broad, has two columns at 5 m spacing. If the depth of the footing is 750 mm, examine that we can adopt rigid beam analysis. Assume the modulus of subgrade reaction is 2.5 kg/cm^3 . 6 + 8