M.E. (Civil) 2nd Semester Examination, 2013
Foundation Engineering–II (CE–1010)

Full Marks: 100 Time: 3 hours

Answer any *FOUR* questions

1.(a) Distinguish between driven and bored cast-in-situ piles. Discuss their relative advantages and disadvantages.

(b) Under what conditions may negative skin friction develop? How would you compute the axial load-carrying capacity of a pile subjected to negative skin friction?

(c) Determine the safe load that can be carried by a precast RCC pile of 300 mm diameter and an embedded length of 22 m from the following data:

weight of hammer = 20 kN
height of free fall = 910 mm
efficiency of hammer blows = 75%
average penetration in the last 5 blows = 10 mm
co-efficient of restitution = 0.55

Use modified Hiley's formula. Assume a factor of safety of 3. (7+8+10=25)

2. (a) Discuss the advantages of precast piles over cast-in-situ piles. Comment on the suitability of precast piles in (i) clay (ii) sand deposits.

(b) A bored pile is to be installed at a site where the subsoil conditions are as follows:

Layer No.	Type of soil	Depth (m)		Average Properties
		from	to	
1	Dessicated clay	0.0	0.8	$\gamma = 16.0$ kN/m^3, $q_u = 90$ kPa
2	Medium clay	0.8	7.8	$\gamma = 15.8$ kN/m^3, $\gamma_{sat} = 18.5$ kN/m^3, $q_u = 65$ kPa
3	Soft clay with organic matters	7.8	11.5	$\gamma = 16.6$ kN/m^3, $\gamma_{sat} = 19.2$ kN/m^3, $q_u = 36$ kPa
4	Stiff clay	11.5	30.0	$\gamma = 19.5$ kN/m^3, $\gamma_{sat} = 20.0$ kN/m^3, $q_u = 121$ kPa

The Ground water table is at 1.8 m below GL. The length and diameter of the pile are 16 m and 400 mm respectively. The cut-off level of the pile is at 1.5 m below GL. Compute the safe bearing capacity of the pile. Assume reasonable values for any data not supplied. (10+15=25)

3. (a) A precast pile of length L has to be lifted horizontally with the help of a crane. Ropes are tied at two points located at equal distances of x from the right and left ends of the pile. Determine the optimum value of x/L that will result in the minimum bending moment in the pile when lifted.

(b) A driven pile of length 20 m and diameter 450 mm has been installed in a cohesionless soil deposit having the following properties:

from GL to 5 m below it: $\gamma = 17.5$ kN/m^3, $\phi = 0°$, $q_u = 45$ kPa, $\alpha = 0.9$

from 5 m to >20 m: $\gamma_{sat} = 18$ kN/m^3, $\phi = 30°$, $K_s = 0.65$

The water table is at 5 m below GL The values of Berezantsev's bearing capacity factor are given below:

ϕ (°)	Bearing capacity factor, N_q		
	$D_f/B=5$	$D_f/B=20$	$D_f/B=70$
25	18.8	9.3	4.5
30	27.4	21.1	16.9

Determine the safe load carrying capacity of the pile with respect to a factor of safety of 3. (8+17=25)

4. A raft footing is supported by a group of 96 piles, arranged in a formation of 8 x 12. The diameter and length of each pile are 350 mm and 22.5 m respectively and they are spaced 1.5 m apart. The depth of foundation of the raft is 1.2 m. The soil below is a clay deposit having the following average properties:

$\gamma_{sat} = 19.9$ kN/m^3, $q_u = 48$ kPa, $\alpha = 0.85$

The raft is projected on each side by 0.6 m from the edges of the outermost piles. Assuming the ground water table to be at ground level, determine the safe load carrying capacity of the raft.

5. (a) Distinguish between the following:

(i) initial test and routine test.
(ii) working pile and test pile
(iii) maintained load test and cyclic load test.

(b) Draw a typical load-settlement curve as obtained from a maintained load test. How would you determine the maximum load that should be applied on the pile during the test?

(c) Describe the procedure to determine the shaft resistance and point-bearing resistance of a test pile from the results of a cyclic load test. (6+4+15=25)

6. A pile group supporting a raft footing of 12 m x 16 m has to withstand an *udl* of 400 kN/m^2, including the weight of the pile cap. The water table is at G.L. and depth of the pile cap is 1.5 m below that. The subsoil consists of a stratum of normally consolidated clay that extends to 25 m below the ground level and is underlain by a loose sand deposit, having a relative density of 0.45. The average values of the saturated density and the unconfined compressive strength of the soil are 19.5 kN/m^3 and 75 kPa respectively. The adhesion factor may be taken as 0.8. Design a suitable pile group to support the raft. Assume a factor of safety of 3.

7. In a piled raft foundation, the pile group consists of 121 piles arranged in a square formation. The diameter and length of each pile are 450 mm and 18 m respectively, while their spacing is 1.6 m c/c. The raft is founded at a depth of 1.5 m below GL and carries a gross vertical stress of 100 kN/m^2. The projection of raft on all sides beyond the outer edges of the piles is 0.8 m. The properties of the subsoil are as follows:

$w = 32\%$, $G = 2.72$, $LL = 41\%$

Estimate the probable consolidation settlement of the pile group.