Ref. No. : Ex/CE/PC/B/T/412/2024

B.E. CIVIL ENGINEERING FOURTH YEAR FIRST SEMESTER – 2024
SUBJECT: GEOTECHNICAL ENGINEERING III
Time: 3 HOURS Full Marks : 100
PART I (50 MARKS)
Assume reasonable values of data not supplied

1. **CO1**

Draw a Newmark's chart used for determining vertical stresses below a loaded area. Show all relevant calculations

Using this Newmark's chart determine the vertical stresses 5m and 15m below the centre, half radius and edge of a circular petroleum steel storage tank of diameter 30m resting over ground surface. Take maximum pressure over the ground = 8 t/m^2. 12+8=20

2. **CO3**

Using the above stresses determine the consolidation settlement below the centre, half radius and edge of the tank for the subsoil data given below. Take ground water table 2m below ground surface. 10

Stratum I (0 – 10m) : γ_{sat}=18.0kN/m^3, Cc/1+e_0 = 0.13

Stratum II (10 – 20m) : γ_{sat}=19.5kN/m^3, Cc/1+e_0 = 0.08

Below this there exists a deep deposit of sand (N>40).

3. **CO 5**

A pile group is to be constructed to support design column load (vertical) of 3000kN. Subsoil at the site consists of top soft clay of thickness 15m (undrained cohesion Cu = 25kPa, α=1.0, γ_{sat}=17.5kN/m^3, Cc/1+e_0 = 0.15) followed by a layer of medium / stiff clay (undrained cohesion Cu = 75kPa, α=0.64, γ_{sat}=19.0kN/m^3, Cc/1+e_0=0.08) down to 22.0m below ground level. This is underlain by a deep deposit of hard clay with undrained cohesion 120kPa (α=0.42), bulk density 19.5kN/m^3 and Cc/1+e_0=0.07. GWT is at the ground level.

Take length of pile = 25m, diameter = 500mm and cut-off level at 2.0m below existing ground level.

Determine the safe vertical capacity of single pile using α method with a factor of safety of 2.5. Design the pile group and also determine the settlement of the pile group under superimposed vertical load. 20

[Turn over

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GEOTECHNICAL ENGINEERING III

PART-II

[Answer All the Questions]

Total = 100

This Part = 50

[Use code: IS: 6403, IS: 2131, IS: 1904, IS: 8009 (Part-I) & IS1893(Part-I)-2016]

1. **[CO4]**	A raft foundation with dimensions 6.5m x 13m is to be constructed at a depth 1.75m below ground surface. The net foundation pressure can be taken as 45 kN/m^2. Calculate the total settlement of the foundation. The subsoil profile is given in figure (Fig. 1) below. [*Assume water table at 1m below ground surface*] G. L. Silty Clay $\gamma = 1.8$ t/m^3 $\gamma' = 0.9$ t/m^3, $\frac{C_c}{1+e_0} = 0.05$ 4.0m Silty Clay $\gamma = 1.8$ t/m^3, $\frac{C_c}{1+e_0} = 0.15$ 11.0m Silty Clay with Kankar $\gamma = 1.9$ t/m^3, $\frac{C_c}{1+e_0} = 0.09$ 20.0m **Fig. 1**	[15]
2. **[CO4]**	Column carrying a superimposed load of 650 kN is to be founded on a sandy deposit as shown in the figure (Fig. 2) below. Design a suitable isolated footing for the same. G. L. 1.5m Loose whitish grey silty fine sand $\gamma = 1.85$ t/m^3, $\varphi' = 30$, Avg. N = 10 4.0m Medium dense brownish grey silty fine sand with mica $\gamma = 1.87$ t/m^3, $\varphi' = 32$, Avg. N = 15 10.0m Dense to very dense brownish grey silty fine sand $\gamma = 1.93$ t/m^3, $\varphi' = 34$, Avg. N = 24 20.0m	[20]

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GEOTECHNICAL ENGINEERING III

PART-II

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Total = 100

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3. **[CO6]**

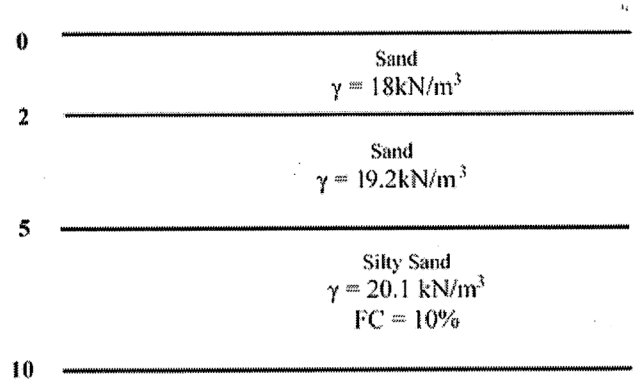
At a project site SPT tests have been carried out at every 0.75m depth. The measured penetration resistance with depth is given in the table (Table 1) below and the soil profile obtained from the bore-log data is also shown in figure (Fig. 3) below. The region is expected to experience an earthquake of magnitude 7.0. The project site is estimated to experience a_{max} of '0.25g' ground shaking under the expected earthquake. Estimate the liquefaction potential of the site at every 0.75m depth interval and also prepare a plot of depth vs CSR/ CRR showing the liquefied zone.

Table 1

Depth (m)	0.75	1.5	2.25	3.0	3.75	4.5
N-value	6	4	6	8	15	12

Given:

[SPT conducted following IS standard
Use unit weight of water, γ_w = 10 kN/m^3 in the calculations]
Assume Water Table at ground surface]



[15]