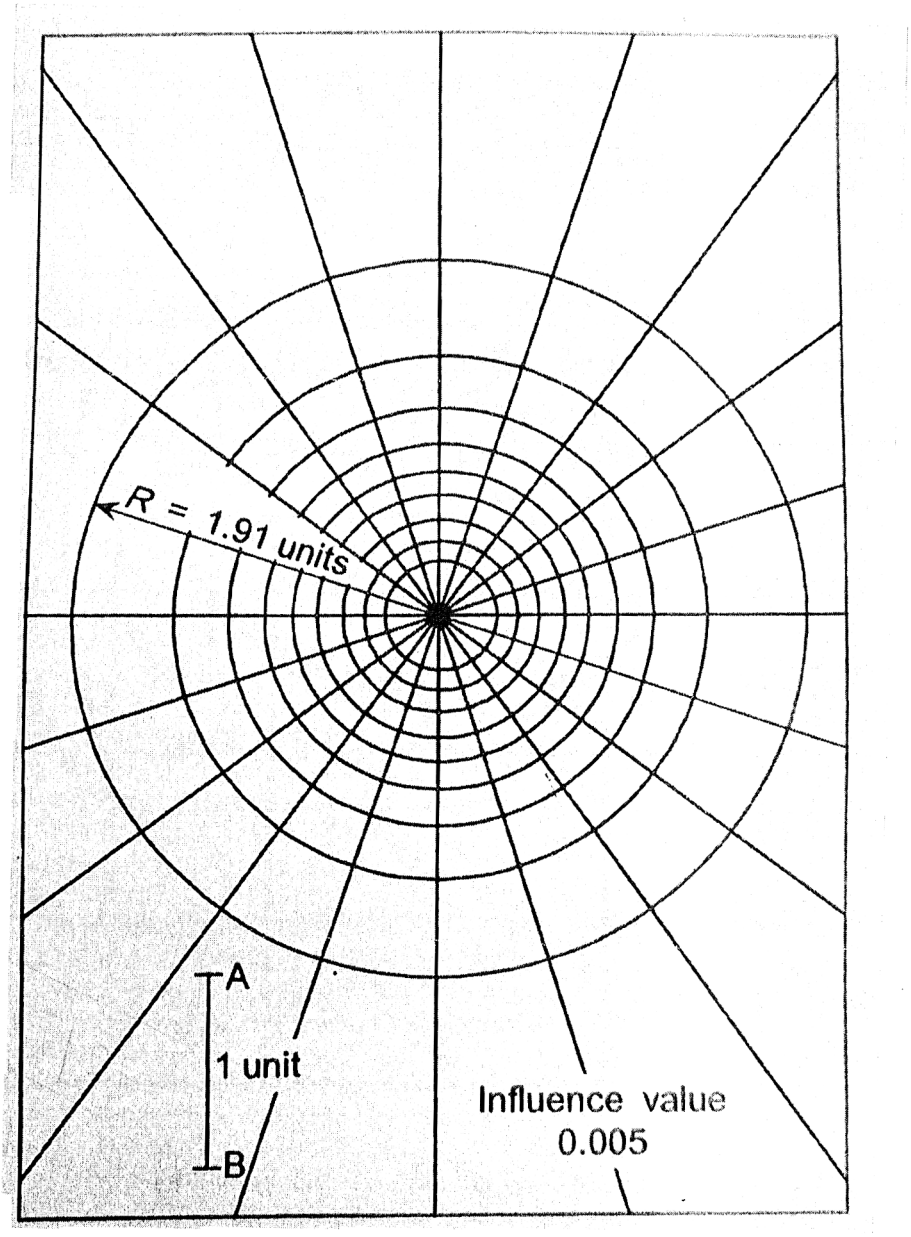
Ref. No. : Ex/CE/PC/B/T/412/2025

B.E. CIVIL ENGINEERING FOURTH YEAR FIRST SEMESTER – 2025
SUBJECT: GEOTECHNICAL ENGINEERING III
Time: 3 HOURS Full Marks : 100
PART I (50 MARKS)
Assume reasonable values of data not supplied
Use separate answer scripts for each Part

1. CO1

Use Newmark's chart (given below) to determine the vertical stresses 2m, 9m and 17m below the centre, one edge and 5m from one edge of a 20m x 20m square raft resting at a depth of 2m below ground level. Take maximum pressure on the raft = 6 t/m^2. 10



[Turn over

2. CO3

Using the above stresses determine the consolidation settlement below the centre, edge and the point 5m from one edge of the raft for the subsoil data given below. Take ground water table 2m below ground surface. 15

Stratum I (0 – 6m) : γ_{sat}=18.0kN/m^3, Cc'/1+e_0 = 0.04, Cc/1+e_0 = 0.14, p_c= 8 t/m^2

Stratum II (6 – 16m) : γ_{sat}=16.5kN/m^3, Cc/1+e_0 = 0.14

Stratum III(16 – 22M) : γ_{sat}=19.5kN/m^3, Cc/1+e_0 = 0.09

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 4000kN. Subsoil at the site consists of top soft clay of thickness 18m (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 = 65kPa, α=0.64, γ_{sat}=19.0kN/m^3, Cc/1+e_0=0.08) down to 23.0m below ground level. This is underlain by a deep deposit of hard clay with undrained cohesion 120 kPa (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. 10+5+10 = 25

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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)]

1. [CO2]

A rectangular footing (1.5m x 2m) is to be constructed at 1.5m depth below ground level. The footing is subjected to a load inclined at 12° to the vertical. The subsoil is mainly clayey silt with saturated unit weight of 18.5 kN/m^3. Water table is located at the base of the footing. Compute the safe load the footing can carry for the following two conditions:

(i) Drained condition: $c' = 12\ kN/m^2, \varphi' = 28^\circ$

(ii) Undrained condition: $c_u = 35\ kN/m^2, \varphi_u = 0$

[*Use IS: 6403-1981 recommendations. General shear failure case may be assumed*]

[14]

2. (a)

Write a short note on 'interference effect' of closely spaced footings.

(b)

A column carrying a load of 500 kN as shown is to be constructed in medium sand as shown in Fig. 1. Design a suitable isolated footing.

[Take, γ_w = 10kN/m^3, *Use IS: 6403-1981 recommendations*]

[Correct N values as per *IS* recommendations]

[CO4]

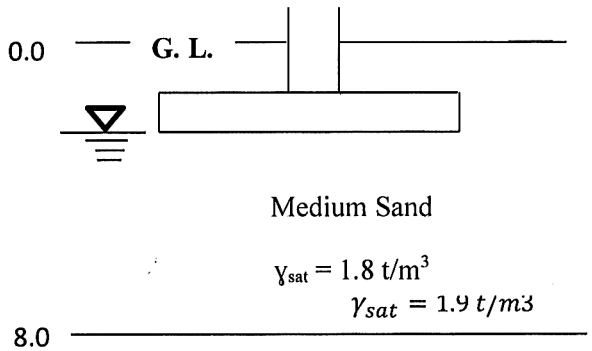

Fig. 1

Depth (m)	N-Value
0.75	5
1.5	6
2.25	8
3.0	11
3.75	14
4.5	18
5.25	19
6.0	22
6.75	24
7.5	27
9.0	30
10.5	31

[6+15]

3. (a)

Differentiate between '*Flow Liquefaction*' and '*Cyclic Mobility*'.

(b)

Discuss '*historical criteria*' and '*compositional criteria*' in liquefaction susceptibility of soil.

(c)

Derive an expression for cyclic stress ratio in cyclic stress approach of evaluation of liquefaction potential.

[CO6]

[4+6+5]