Code No: **R1641013** **R16** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, March – 2021

GEOTECHNICAL ENGINEERING - II

(Civil Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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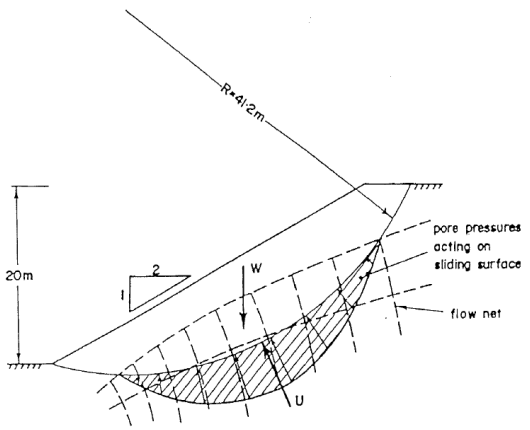
1.Provide Terzaghi's bearing capcity factors table/chart and Fox's depth correction factors.

PART–A *(14 Marks)*

1. a) What modes of failures occur in a finite slope and explain to the point. [3]
   b) Derive an expression for active earth pressure when the ground surface is inclined. [3]
   c) Determine ultimate bearing capacity of a strip footing, 1.2 m wide, and having the depth of foundation of 1.0 m. Use Terzaghi's theory and assume general shear failure. Take $\phi' = 35^o$, $\gamma = 18$ kN/m^3 and $c' = 15$ kN/m^2. [2]
   d) What is negative skin friction? What is its effect on the pile? [2]
   e) Write the types of well foundation and mention any two merits. [2]
   f) List the various methods of boring. [2]

PART–B *(4x14 = 56 Marks)*

2. a) What will be the factors of safety with respect to average shearing strength, cohesion and internal friction of a soil, for which the shear strength parameters obtained from the laboratory tests are $c' = 32$ kN/m^2 and $\phi' = 18°$; the expected parameters of mobilized shearing resistance are $c_m' = 21$ kN/m2 and $\phi' = 13°$ and the average effective pressure on the failure plane is 110 kN/m^2 . For the same value of mobilized shearing resistance determine the following:
   i) Factor of safety with respect to height;
   ii) Factor of safety with respect to friction and cohesion is unity; and
   iii) Factor of safety with respect to strength. [7]
   b) Using the ordinary method of slices, determine the factor of safety for the slope undergoing seepage and for the failure surface shown in the figure below. The soil properties are: $\gamma = 2$Mg/m^3, $c' = 30$ kN/m^2, $\phi' = 30^o$.



[7]

3. A retaining wall with a smooth vertical back retains sand backfill for a depth of 7m. The backfill has a horizontal surface and has c'= 0, ϕ'= 25^o, γ=17 kN/m^3, γ_{sat}= 20 kN/m^3. Calculate the magnitude of the total thrust against the wall for the conditions given below:
i) Backfill fully drained but the top of the wall is restrained against yielding, ii) backfill fully drained and the wall is free to yield, and iii) wall free to yield, water table at 3 m depth and there is no drainage. Determine the point of application of the resultant thrust for case iii. [14]

4. a) i) Explain the factors affecting bearing capacity of soil.
ii) Write the factors affecting the location of foundation. [7]
b) A 30 cm square test plate settles by 18 mm in a plate load test conducted on a granular soil when the loading intensity was 200 kN/m^2. Estimate the likely settlement in a footing 1.5 m square, resting on the same soil, at the same intensity of loading. [7]

5. a) A bored pile in a clayey soil failed at an ultimate load of 400 kN. If the pile is 40 cm diameter and 10 m long, determine the capacity of a group of nine piles, spaced 1 m center to center both ways. Take α= 0.5. [7]
b) Explain in detail the classification of piles. [7]

6. a) A circular well of 6 m external diameter and 4 m internal diameter embedded to a depth of 15 m below the maximum scour level in a sandy soil deposit. The well is subjected to a horizontal force of 800 kN acting at a height of 8 m above the scour level. Determine the allowable total equivalent resisting force due to earth pressure, assuming the rotation is at the base. Take γ_{sat}= 20 kN/m^3, ϕ= 30^o; factor of safety for passive resistance= 2.0. Use Terzaghi's analysis. [4]
b) Explain the various stages of construction and sinking of well. [10]

7. a) Describe in brief the various geo-physical methods of investigation. Discuss their limitations and use. [10]
b) The field N value in a deposit of fully submerged fine sand was 40 at a depth of 6 m. the average saturated unit weight of the soil is 19 kN/m^3. Calculate the corrected N value as per IS code. [4]

Code No: **R1641013** **R16** **Set No. 2**

IV B.Tech I Semester Regular/Supplementary Examinations, March – 2021

GEOTECHNICAL ENGINEERING - II

(Civil Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
****

1. Terzaghi's bearing capcity factors chart/table to be provided

PART–A *(14 Marks)*

1. a) Write the expressions for factor of safety with respect to strength, cohesion and friction angle. [3]
   b) Compare the assumptions of Rankine's and Coulomb's theories. [2]
   c) Define the following terms: Net safe bearing capacity, Gross safe bearing capacity and Allowable soil pressure. [3]
   d) A 30 cm diameter concrete pile is driven into a homogenous consolidated clay deposit (c_u= 40 kN/m^2, α= 0.7). If the embedded length is 10 m, estimate the safe load (F.S =2.5) [2]
   e) List the various components of well foundation. [2]
   f) What are the various methods of drilling holes for sub-surface investigations? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Obtain the factor of safety and analyze the slope of infinite extent having slope angle= 25^o if it is made of clay having c'= 30 kN/m^2 , ϕ' = 20°, e = 0.65 and G_s = 2.7 and under the following conditions: (i) when the soil is dry, (ii) when water seeps parallel to the surface of the slope, and (iii) when the slope is submerged. [10]
   b) A vertical cut is to be made in clayey soil for which tests gave c= 30 kN/m2, γ= 16 kN/m^3 and ϕ= 0. Obtain the maximum height for which the cut may be temporarily unsupported. For ϕ= 0, and i= 90^o, Taylor's stability number is 0.261. [4]

3. a) A smooth vertical wall retains a horizontal granular backfill. Determine the Rankine's and Coulomb's active and passive pressure coefficients for ϕ'= 30^o, 35^o, and 40^o. [7]
   b) A vertical retaining wall 10 m high supports a cohesionless soil (γ= 18 kN/m^3). The upper surface of the backfill rises from the crest of the wall at an angle 15^o with the horizontal. Determine the total active earth pressure by Culmann's method. [7]

4. a) A 2.5 m wide square footing is placed at 1.0 m depth in sand where γ= 18.5 kN/m^3 and q_c= 8.0 MN/m^2. The pressure applied at the foundation level is 150 kN/m^2. Bedrock lies at 4.0 m depth. Determine the settlement in 20 years. [7]

   b) A strip footing 1.2 m wide, is supported on a soil with its base at a depth of 1 m below ground surface. The soil properties are c'= 15 kN/m^2, ϕ'= 28^o, γ_t= 18 kN/m^3, γ'= 10 kN/m^3. Determine the ultimate bearing capacity if (i) water table is at a great depth (ii) water table is at the level of the base of the footing and (iii) water table is at the ground surface. Use the Terzaghi equation. [7]

5. a) The following data was obtained in a vertical pile load test on a 300 mm diameter pile:

Load (kN)	50	100	200	300	400	500	600
Settlement (mm)	2.5	4.0	9.5	16.5	27.0	40.5	61.0

   Plot the load-settlement curve and determine the allowable load as per IS code. [10]

   b) A pile load test on a 40 cm diameter concrete pile in a deposit of sand indicates a settlement of 4 mm under a load of 400 kN. Estimate the settlement of a 4x4 pile group. The piles are driven at a spacing of 100 cm. the total load on the group is 6400 kN. [4]

6. a) Explain with a neat figure various components of a well foundation and their uses. [7]

   b) A circular well of 5 m external diameter and steining thickness 1 m is used as foundation for a bridge pier in a sandy stratum. The submerged unit weight of sand is 1.0 t/m^3 and angle of shearing resistance, ϕ= 30^o. The well is subjected to a horizontal force of 50 t and a total moment of 500 t-m at the scour level. The depth of well below scour level is 12 m. Assuming the well to be light, check the lateral stability of the well. [7]

7. a) What are the factors that affect the sample disturbance? How are these minimized? [7]

   b) Describe any two types of samplers used for obtaining undisturbed samples. [7]

Code No: **R1641013** **R16** **Set No. 3**

IV B.Tech I Semester Regular/Supplementary Examinations, March – 2021

GEOTECHNICAL ENGINEERING - II

(Civil Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

1. ***Taylor's Stability chart for ϕ=0 may be provided.***
2. ***Terzaghi's bearing capcity factors chart/table to be provided.***

PART–A *(14 Marks)*

1. a) A cut of depth 10 m is made in a cohesive soil deposit (c= 30 kN/m^2, ϕ= 0 and γ= 19 kN/m^3). There is a hard stratum under the cohesive soil at a depth of 12 m below the original ground surface. If the required factor of safety is 1.50, determine the safe slope. [3]
   b) Define earth pressure at rest. Show the distribution of earth pressure on a retaining wall, assuming the soil to be dry. [2]
   c) What are the different types of settlements, which can occur in a foundation? How are these estimated? [3]
   d) Describe any two different categories of piles and classification of pile foundations. [2]
   e) List the various forces acting on a well foundation. [2]
   f) What are the various corrections applied to a standard penetration test result. [2]

PART–B *(4x14 = 56 Marks)*

2. a) An infinite slope consists of 5m of soil lying on top of bedrock. The bedrock and the soil surface are both inclined at 23^o to the horizontal. The soil properties are: γ= 18.5 kN/m^3, c'= 15 kN/m^2, and ϕ'= 20^o. Assume the slope is dry.
      i. What is the maximum shear stress developed within the soil?
      ii. What is the maximum shear strength available in the soil?
      iii. What is the factor of safety for the slope?
      iv. What should be the maximum possible depth for the soil before it becomes unstable?
      v. Assuming the friction is fully mobilized, what is the factor of safety with respect to cohesion? [10]
   b) Determine the critical angle of an infinite slope in a clay soil having c'= 20 kN/m^2, ϕ'= 20^o, G_s= 2.72, and e= 0.9 when it is in its dry state. [4]

3. A retaining wall with a vertical back, 8m high, supports a sand soil with c'= 0 and ϕ'= 34^o. Neglecting wall friction, calculate the total active thrust on the wall, if
      i) the water table is below the base of the wall (γ= 16 kN/m^3).
      ii) The water table rises up to a height of 4m above the base of the wall (γ_{sat}= 20.5 kN/m^3).
      iii) The water table rises up to the ground surface.
      iv) If the wall is restrained against yielding, what is the magnitude of the lateral thrust for conditions at (i). [14]

4. a) A 2.0 m wide continuous foundation carries a wall load of 350 kN/m in a clayey soil where γ= 19.0 kN/m^3, c'= 5 kN/m^2 and ϕ'= 23^o. The foundation depth is 1.5 m. Determine the factor of safety of this foundation. [7]
   b) A 5m x 10m flexible raft foundation applies a net uniform pressure of 250 kN/m^2 to the underlying soil. The foundation is placed 5 m below the ground level, and there is bedrock at a depth of 5 m below the bottom of the raft. The modulus of elasticity and Possion's ratio of the soil are 40 MN/m^2 and 0.3 respectively. Determine the elastic settlement at the center and corner of the foundation. [7]

5. a) A group of nine piles arranged in a square pattern is to be proportioned in a deposit of soft clay. Assuming the piles to be square (with side 300 mm) and 10 m long, work out the spacing for 100 per cent efficiency of the pile group. Neglect bearing and assume adhesion factor of 0.8. [7]
   b) A 500mm x 500mm concrete pile, 15 m long, penetrates a deep uniform deposit of clay (c_u= 40 kN/m^2) and rests in a stratum of good bearing. Estimate the load taken by skin friction. Assume the adhesion factor to be 0.8. [7]

6. a) A circular well of 5 m external diameter and steining thickness 1 m is used as foundation for a bridge pier in a sandy stratum. The submerged unit weight of sand is 1.0 t/m^3 and angle of shearing resistance, ϕ= 30^o. The well is subjected to a horizontal force of 50 t and a total moment of 500 t-m at the scour level. The depth of well below scour level is 12 m. Assuming the well to be heavy, calculate the total horizontal equivalent force the well can resist. Further, what will be the change in value, if the maximum scour level is subjected to a surcharge equivalent to 2 m height of soil. [10]
   b) Discuss various situations where well foundation is more suitable than any other type of foundation with proper reasons. [4]

7. a) Detail the procedure adopted and significance of the three penetration tests conducted on soils in-situ. [9]
   b) Describe the salient features of a good sub-soil investigation report. [5]

Code No: **R1641013** **R16** **Set No. 4**

IV B.Tech I Semester Regular/Supplementary Examinations, March – 2021

GEOTECHNICAL ENGINEERING - II

(Civil Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

*****

1. ***Terzaghi's bearing capacity factors chart/table and Fox's depth correction factor chart to be provided.***
2. ***Values of Nq chart for piles to be provided.***

PART–A *(14 Marks)*

1. a) Define Translational slides and Depth factor in infinite slope failure analysis. [2]
   b) List and brief the categories of lateral earth pressures. [3]
   c) Differentiate between local shear failure and general shear failure. [2]
   d) List out different methods of installation of piles. [2]
   e) List different shapes of wells and describe the features of any two. [2]
   f) The cone penetration resistance obtained in a clay soil in a CPT was 50 kg/cm^2. Determine the undrained strength of the clay. The total overburden pressure at the depth was 100 kN/m^2. [3]

PART–B *(4x14 = 56 Marks)*

2. a) An infinite slope consists of bedrock inclined at 15^o to the horizontal that is covered by 4 m (measured vertically) soil with c'=10 kN/m^2, ϕ' = 24^o and γ = 19.0 N/m^3. What is the factor of safety of this slope? If there is steady state seepage through the soil, with the water table coinciding with the ground level, what would be the factor of safety? Assume γ_{sat} = 20.5 kN/m^3. [7]
   b) A dam of homogenous section is 25 m high with upstream slope of 2.5 to 1.0 and downstream slope of 2 to 1. There is a 12 m long horizontal filter at the downstream end. Taking a free board of 3m, determine the i) factor of safety of downstream slope under steady seepage conditions ii) factor of safety of upstream slope under sudden drawdown conditions. [7]

3. A retaining wall 6 m high, vertical back, supports a saturated clay soil with a horizontal surface. The properties of the backfill are: ϕ_u= 0, c_u= 35 kN/m^2, γ= 17 kN/m^3. Assuming the back of the wall to be smooth, determine:
   i) the depth of tension cracks
   ii) the critical depth of a vertical cut
   iii) the total active thrust against the wall and its point of application, if cracks are formed in the tension zone
   iv) What will be the depth of tension cracks, if any, if the backfill carries a uniform surcharge of 30 kN/m^2 over the backfill surface? What will be the position of the total active thrust? [14]

Code No: **R1641013** **R16** **Set No. 4**

4. a) The following data was obtained from a plate load test carried out on a 60 cm square test plate at a depth of 2 m below ground surface on a sandy soil, which extends up to a large depth. Determine the settlement of a foundation 3.0m x 3.0m carrying a load of 110 t and located at a depth of 3m below ground surface.
Load test data:

Load intensity, t/m^3	5	10	15	20	25	30	35	40
Settlement, mm	2.0	4.0	7.5	11.0	16.3	23.5	34.0	45.0

Water table is located at a large depth from the ground surface. [7]

b) Using the above test data (Q.4a), determine the allowable load on a 1.5m x 1.5m column footing ith its base at a depth of 2 m. The permissible settlement for the foundation is 20 mm and a minimum factor of safety of 3 is required against shear failure. The unit weight of the soil determined at the base of the test pit by the core cutter method was 2.0 t/m^3 [7]

5. a) A 30 cm diameter pile of length 12 m was subjected to a pile load test and the following results were obtained.

Load (kN)	0	500	1000	1500	2000	2500
Settlement during loading (cm)	0	0.85	1.65	2.55	3.8	6.0
Settlement during unloading (cm)	4.0	4.6	5.2	5.5	5.8	6.0

Determine the allowable load. [7]

b) A 400mm x 400mm reinforced concrete pile is driven through a deposit of fine loose sand and soft clay 20 m thick, to a depth of 1.0 m into an underlying stratum of dense sand. The water table is located close to the ground surface. In submerged state, the angle of shearing resistance of sand was 35^o and unit weight 10 kN/m^3. Calculate the point bearing resistance of the pile. [7]

6. Discuss in detail the causes and remedies for tilts and shifts in well foundations with figures. [14]

7. a) Explain the various methods of boring elaborately. [7]

b) Determine the area ratios for the following soil samplers and comment on the nature of samples obtained in each of the samplers.

i)	Core cutter	165 mm OD	150 mm ID
ii)	Split barrel	51 mm OD	35 mm ID
iii)	Seamless tube (Shelby)	51 mm OD	48 mm ID

[7]