IV B.Tech. I Semester Regular Examinations, November -2005
FOUNDATION ENGINEERING
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What is meant by geophysical methods of soil exploration? Describe the two most commonly used geophysical exploration methods and compare their merits and demerits. [16]

2. (a) Describe a suitable method of stability analysis of slopes in [8]
   i. purely saturated cohesive soil, and
   ii. Cohesionless sand
   (b) Critically discuss the basic assumptions made in the stability analysis of slopes. [2]
   (c) A slope is to be constructed in a soil for which $c^- = 0$ and $\phi^- = 36^0$. It is to be assumed that the water level may occasionally reach the surface of a slope, with seepage taking place parallel to the slope. Determine the maximum slope angle for a factor of safety 1.5, assuming a potential failure surface parallel to the slope. What would be the factor of safety of the slope, constructed at this angle, if the water table should be well below the surface? The saturated unit weight of the soil is 19 kN/m^3. [6]

3. (a) Compare Rankine's and Coulomb's theory of earth pressure.
   (b) A 5m high rigid retaining wall has to retain a backfill of dry, cohesionless soil having the following properties:-
   ϕ= 30^0, void ratio, e= 0.74, G= 2.68
   Plot the distribution of Rankine lateral earth pressure on the wall and determine the magnitude and point of application of the resultant thrust. [8+8]

4. A retaining wall 6m height retains a soil with the following properties:
   c′= 0, $\phi' = 34^0$, γ= 19 kN/m^3, δ= 20^0The backfill surface is sloping at an angle 20^0 to the horizontal. The back surface of the wall is inclined at an angle of 15^0 with the vertical.
   (a) Determine the total active thrust by Culmanns graphical construction.
   (b) A vertical line load of 60 kN/m is acting at a horizontal distance of 3.5m from the wall parallel to the crest of the wall. What is the magnitude of total active thrust? [16]

5. (a) Define the terms: [4]

i. ultimate bearing capacity
ii. net safe bearing capacity
iii. net safe bearing pressure
iv. net ultimate bearing capacity. [6]

(b) Define:

i. Local shear failure and
ii. General shear failure. Illustrate with sketches.

(c) A square footing rests on a pure clay with unconfined compressive strength of 270kN/m^2 at a depth of 1.8m. Determine the size of the footing if it has to transmit a load of 720kN. Assume the bulk unit weight of soil as 18kN/m^3 and factor of safety as 3.0. [6]

6. (a) A footing, 2.5 m square, is founded at a depth of 1.8 m in a sand deposit, for which the corrected value of N is 27. The water table is at a depth of 2 m from the surface. Determine the net allowable bearing pressure, if the permissible settlement is 40 mm and a factor of safety of 3 is desired against shear failure.

(b) Plate load test data is given below. Plot the load-settlement curve and find the ultimate bearing capacity. Take width of plate as 300 mm and least count of dial gauge as 0.01 mm. [8+8]

Load intensity (kPa)		Dial gauge reading	
	A	B	C
0	0	0	0
55	186	192	192
110	362	365	353
165	766	758	756
220	1886	1889	1865
280	4810	4806	4784
335	14006	14010	13984

7. (a) What is the basis on which the dynamic formulae are derived? Mention two well known dynamic formulae and explain the symbols involved?

(b) A friction pile 300mm in diameter is proposed to be driven in a layer of uniform cohesive soil. The pile tip is assumed to carry 20% of the load. The skin friction between the pile surface and the soil is assumed to be 50kN/m2. Determine the length of piling required to carry a safe load 200kN with a factor of safety of 4.

[8+8]

8. (a) Discuss about pile load tests.

(b) A group of 12 piles each having a diameter of 500mm and 30 metres long supports a column. The piles are arranged in 3 rows and spaced at 1.25 metres c/c. The properties of the foundation soil (clay) are as follows:-Unit weight

= 11 kN/m^3, Unconfined compressive strength = 100 kN/m^2.Determine the capacity of the pile group. [8+8]

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1. (a) What are the various steps considered in the planning of sub-surface exploration programm? Discuss in detail. [10]
   (b) Explain the significance of
      i. inside clearance
      ii. outside clearance and
      iii. area ratio. [6]

2. (a) What is Taylor's stability number? How do you use the stability chart? [6]
   (b) Give the step by step procedure for analyzing the stability of the upstream slope of an earth dam by the Swedish method of slices. Bring out the effect of sudden draw down on the stability of slope. [10]

3. (a) Derive an expression for active pressure when the ground surface is inclined.
   (b) The consolidated drained shear tests on silt yielded the following data:

σ_3(kN/mm^2)	σ_1(kN/mm^2)
0.20	0.46
0.40	0.88

   If this material is used as a backfill for a smooth vertical retaining wall of 10m height, what is the active earth thrust on the back of wall? What is its point of location? Density of the backfill 16 kN/m^3. [8+8]

4. (a) Discuss with neat sketches various types of retaining walls. [6]
   (b) Discuss the stability of gravity retaining wall. [10]

5. (a) Briefly Explain how do you proceed to choose a type of foundation.
   (b) A strip footing 1.5 m wide is supported on soil with its base at a depth of 1.2 m below ground surface. The soil properties are as under:
   $c' = 20$ kN/m^2, $\phi' = 20^0$, $\gamma_t = 18$ kN/m^3 and $\gamma' = 10$ kN/m^3.
   Determine the net ultimate bearing capacity and the safe bearing capacity using Terzaghis equation for General shear failure, when water table is at the level of the base of the footing. Take factor of safety = 2.5. For $\phi' = 20^0$, assume $N_c = 15$, $N_q = 6.4$, and $N_\gamma = 5.4$. [8+8]

6. (a) Write the notes on allowable settlements of various structures.
   (b) Discuss the various methods of determination of the allowable soil pressure. What are their limitations? [8+8]

7. (a) What are the uses of pile foundations? [4]
   (b) Write a note on under-reamed piles. [6]
   (c) Determine the ultimate load-carrying capacity of a precast concrete pile having a side of 450mm, driven 20m into a soft clay having undrained cohesion of 30kPa and saturated unit weight of 18 kN/m^3. Ground water table occurs at the ground surface. Adopt α- method. [6]

8. (a) Explain Terzaghi's block shear method for estimation of efficiency of pile group. [4]
   (b) Briefly outline how the load carrying capacity of pile is determined in the field? What are its limitations? [8]
   (c) What is the meaning of 'efficiency' of a pile group? [4]

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1. (a) Describe, in brief, various geophysical methods. Discuss their limitations and uses. [10]
   (b) Write a critical note on vane shear test. [6]
2. (a) What is meant by 'Taylor's stability' number? Where do you make use of it?
   (b) Distinguish between 'total stress analysis' and 'effective stress analysis' in slope stability problems. Under what conditions each is used. [8+8]
3. (a) Explain the following: [6]
      i. Angle of repose
      ii. angle of internal friction and
      iii. angle of wall friction.
   (b) To what depth an unsupported vertical cut can be made in a clayey soil whose unconfined compression strength is 80kN/m^2. Take γ=20.5kN/m^3. [4]
   (c) A retaining wall slopes away from the filling at an angle of 75^0 to the horizontal. The angle of surcharge is 6^0, the angle internal friction is 30^0 and the angle of wall friction is 22^0. The wall is 7.0m in vertical height and the filling weight is 1.9g/cc. Find the value of maximum active earth pressure. [6]
4. (a) Discuss the stability of retaining walls
   (b) Write a brief note on 'Trial wedge' graphical method [8+8]
5. (a) Define the terms: [4]
      i. ultimate bearing capacity
      ii. net safe bearing capacity
      iii. net safe bearing pressure
      iv. net ultimate bearing capacity. [6]
   (b) Define:
      i. Local shear failure and
      ii. General shear failure. Illustrate with sketches.
   (c) A square footing rests on a pure clay with unconfined compressive strength of 270kN/m^2 at a depth of 1.8m. Determine the size of the footing if it has to transmit a load of 720kN. Assume the bulk unit weight of soil as 18kN/m^3 and factor of safety as 3.0. [6]

6. (a) How do you estimate the settlement of a footing on sand using the results of a plate load test? [10]

   (b) Proportion a square footing to carry a load of 1500 kN from a column. The depth of foundation is to be kept at 2m below ground surface. Maximum settlement of the footing is 40mm and a factor of safety of 3 is required against shear failure. The subsoil is sand with an average corrected N value of 18 as as established from borings. Water table is at a large depth. Use Teng's correlations. [6]

7. (a) Distinguish between the dynamic and static methods of estimation of pile capacity. Discus Hiley's formula. [10]

   (b) A 300mm square pile 15m long is driven in a deposit of medium dense sand (ϕ= 36^0, N_c= 38, N_q=40 and N_γ= 42). The unit weight of sand is 15 kN/m3. What is the allowable load assuming a factor of safety of 3? Assume the lateral earth pressure coefficient as 0.5. [6]

   [4]

8. (a) Describe the procedure for conducting an initial test in compression. How is the safe load on the pile determined from such a test?

   (b) In a 16 pile group, the pile diameter is 50 cm and centre to centre spacing of the square group is 1.5m. If cohesion= 60 kN/m^2, determine whether the failure would occur with the pile acting individually or as a group? All piles are 11m long. Take α= 0.75. Neglect bearing at the top of the pile. [8+8]

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Code No: RR410102 **Set No.4**

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1. (a) How would you obtain a hand-carved sample?
   (b) How would you conduct an in-situ vane shear test? What is its use? [8+8]

2. (a) Show that the factor of safety of an infinite slope in a cohesionless soil is independent of its height and the unit weight of soil. [8+8]
   (b) Figure 1 shows the details of an embankment made of clay C_u=20 kPa and ϕ_u=0^0. the unit weight of soil is 19 kN/m^3. For the trial slip circle shown, determine thefactor ofsafety against sliding. The weight of sliding mass is 346 kN, acting at an eccentricity of 5m. What would the factor of safety.
      i. if the tension cracks do not form
      ii. if the tension crack forms?

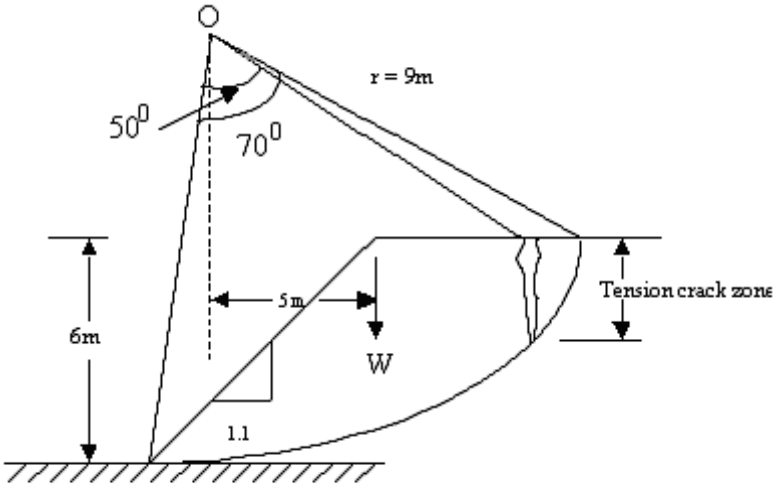

Figure 1:

3. (a) What is depth of "Tension crack"? When does it develop? [4]
   (b) A 4m high vertical wall supports a saturated cohesive soil (ϕ=0) with horizontal surface. The top 2.5m of the backfill has bulk density of 17.0 kN/m^3 and apparent cohesion of 15 kN/m^2. The bulk density and apparent cohesion of the bottom 1.5m is 19 kN/m^3 and 20 kN/m^2, respectively. If tension cracks develop, what would be the total active pressure on the wall? Also draw the pressure distribution diagram. [12]

4. A masonry retaining wall of trapezoidal section with the vertical face on the earth side is 1.5m wide at the top and 3.5m wide at the base and is 5.0m high. It retains a sand fill sloping at 2 horizontal to 1 vertical. The unit weight of sand is 18kn/m^3 and ϕ=30^0. Find the maximum and minimum pressure at the base of the wall assuming the unit weight of masonry as 23kN/m^3. [16]

5. (a) Explain Terzaghi's bearing capacity theory for a shallow foundation. State the assumptions involved. Sketch the slip line fields.

   (b) Determine the breadth of a strip footing required to carry a load of 600 kN/m with a factor of safety of 3 against shear failure. The footing is situated at a depth of 1.0 m below the ground level. Determine the footing size, if

      i. the footing is loaded so fast that there is not enough time for the excess pore water pressure to dissipate

      ii. the footing is loaded gradually giving enough time for the excess pore water pressure to dissipate.

      Given: [8+8]

      c_u = 80 kPa; ϕ_u = 0; γ = 19 kN/m_3
      c' = 0; ϕ' = 30^0
      For ϕ = 30^0, N_c = 23, N_q = 23, N_γ = 20

6. (a) What are the limitations of plate load test? [6]

   (b) Two load tests were conducted at site-one with a 0.5m square test plate and the other with a 1.0m square test plate. For a settlement of 25mm, the loads were found to be 60 kN and 180 kN, respectively in the two tests. Determine the allowable bearing pressure of the sand and the load which a square footing, 2m×2m, can carry with the settlement not exceeding 25mm. [10]

7. (a) Discuss the merits and demerits of precast concrete piles over steel piles. [6]

   (b) Explain the procedure for determining the safe load on an isolated pile embedded [8]

      i. in clays with respect to both undrained and drained conditions [4]

      ii. in sands.

   (c) Discuss different methods for the installation of piles.

8. (a) Briefly explain how the load carrying capacity of a pile is determined using pile load test.

   (b) A pile group of 9 piles 40cm diameter, 120cm centre to centre both ways (symmetrically placed) is driven to a depth of 12m through clay of unconfined compressive strength of 100 kN/m^2 and density of 20 kN/m^3. Assuming adhesion factor of 0.5, calculate the load that the group can carry with a factor of safety of 3.0. [8+8]

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