TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.		**Regular**	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE 602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Classify the shallow and deep foundations according to their soil conditions. [2]

2. a) What is standard penetration test? What are the corrections that must be applied to the SPT-values for sand before they are used in design charts and empirical correlations? [1+4]

   b) What is meant by inside and outside clearance? What are the circumstances which make the plate load test data misleading when used for extrapolation of prototype behaviour? [2+5]

3. a) Explain the various reasons for neglecting the passive pressure during the stability analysis of retaining wall. Describe the Culmann's method for determining active thrust for the inclined backfill carrying the surcharge load. [3+5]

   b) Calculate the total passive thrust and its point of application coming on the back of the following retaining wall. [8]
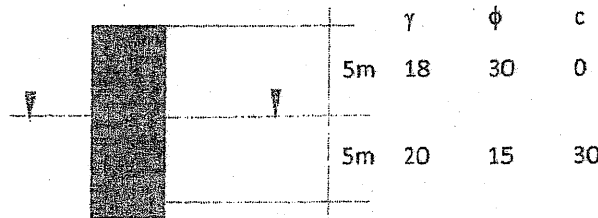
	γ	φ	c
5m	18	30	0
5m	20	15	30

4. What is arching in soil? What are the essential requirements for aching effect to come into play? [1+3]

5. In what respects does the design of bracings in cuts vary from that of a retaining walls? Enlist the types of cofferdam with neat sketches. [2+2]

6. a) Describe the different modes of failure due to the settlement with neat sketches. [5]

   b) Determine the size of the footing resting over sand to carry a column load of 150 tons. The bottom of the footing is 1.5 m below the ground level and water table is located at 3 m below the footing. Take unit weight of sand is 20 KN/m³. Assume $N_c = 55.2$, $N_q = 39.51$ and $N_\gamma = 40.13$. [7]

7. A raft foundation is 20m × 10m exerts a gross pressure of 200KN/m² at the foundation level. The depth of foundation is 2.5m. If the soil is clay $C_u = 80KN/m^2$ and $\gamma = 19$ KN/m³. Determine the Factor of Safety, Use Skemption's equations. [6]

8. a) Describe the various method of determining the settlement of pile group in sand. Describe about the piles subjected to uplift loads. [3+2]

   b) A friction pile 300 mm in diameter is proposed to be driven in a layer of uniform soil having unit skin friction between pile surface and soil as 60 KN/m². Determine the length of the pile required to carry allowable load of 250 KN assuming the pile tip carries 20% of the total load. [7]

9. Define grip length and tilt and shift of well. Describe the various components of well foundation. [2+6]

10. Write down the different methods of soil improvement techniques. Explain about preloading method for improvement of foundation soil. [2+2]

***

Subject: - Foundation Engineering (CE 602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. What are the various factors that influence the choice of a foundation? [2]

2. a) Define the physical meaning of terms with reference to the sampling tube, with a neat sketch i) Inside clearance ratio ii) Outside clearance ratio iii) Area ratio iv) Recovery ratio. Also indicate the recommended values to get least disturbed samples. [6+2]

   b) A multistoried commercial complex building is to be constructed in a core of a Kathmandu Valley, for this a Geotechnical investigation is to be carried out. As an engineer recommend the number of boreholes, depth of boreholes and spacing of the borehole for subsoil explorations. [4]

3. a) How the different retaining walls can be proportioned? Describe the methods of stability check of retaining wall. [5+3]

   b) A retaining wall of 7.5m high has two layers of backfill. The soil supported consists of 3m sand (γ=18KN/m^3, ϕ=35°) overlaying saturated clayey soil (γ=19.5 KN/m^3, ϕ=35°, C=16KN/m^3). The ground water table is at the upper surface of the clay. Make a sketch of the distribution of the active pressure on the wall. Calculate the total earth trust per meter of the wall and its point of application. Assume that the backfill is horizontal at the surface. [8]

4. What is cofferdams? Describe the types of cofferdams with their uses. [1+3]

5. In what respects does the design of bracings in cuts vary from that of a rigid retaining wall? Describe Terzaghi's arching theory. [2+2]

6. a) Critically differentiate between general shear failure and local shear failure. What are the factors affecting bearing capacity of soil? [2+2]

   b) A rectangular footing (3m x 4m) is placed at 1.5m depth in sandy soil having angle of shearing resistance of 34° and unit weight of 20 kN/m^3 above water table and saturated unit weight of 21.5 kN/m^3 below water table. Determine the safe load that can be carried by the footing for a safety factor of 3.0 if the excavation is backfilled for the following cases: (i) the water table is at 1m below the ground level and (ii) the water table is at 1m below the base of the footing. The bearing capacity factors for strip footing for ϕ=34° are N_q=29 and $N\gamma$=41. [8]

7. A raft foundation is 20m x 30m. The raft is constructed over a soft clay stratum having C_u=10KN/m^2 and γ=19KN/m^3. If the live load and dead load on the raft are 100MN, find the depth of Foundation if

   a) The foundation is fully compensated.
   b) Determine the depth of foundation for a factor of safety of 3. [3+3]

8. a) Describe Negative skin friction with its causes, effect, preventive measures. [4]

   b) The 20 numbers of concrete pile of 0.3m diameter and 20 meter depth are designed to construct 4 x 5 layout pattern. The site consist of clay with unconfined compressive strength $80KN/m^2$. Design center to center spacing of piles so that group pile has some possibility of individual pile failure an block failure. Take adhesion factor (α) =0.5 [8]

9. What considerations govern the fixing of the depth of a well foundation? Name the different methods to analyze the lateral stability of well foundation. A circular well of 4m internal diameter and 0.75m steining thickness is embedded upto a depth of 12m in a uniform sandy deposit. The well is subjected to a resultant horizontal force of 500kN and a total moment of 4000kN-m at the scour level. Calculate the allowable total equivalent resisting force due to earth pressure for the both light well and heavy well conditions using Terzaghi's analysis. Take saturated unit weight of soil of $20kN/m^3, \phi=30°$ and factor of safety for passive resistance of 2. [1+1+6]

10. What are the different methods of improving the foundation soils? [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE 602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. Explain the major criteria to be satisfied in the design of a foundation. [2]

2. a) What makes pressure meter testing quite distinctive as compared to other field tests? [2]

   b) List the factors that will consider for deciding the depth of soil exploration. If you are in-charge of subsoil exploration of important structures, how do you decide the depth and lateral extent of soil exploration? [2+5]

   c) A soil sampler has the following dimensions: inside diameter of the cutting edge=69 mm; outside diameter of cutting edge=73 mm; inside diameter of the sampling tube = 70mm and outside diameter of the sampling tube = 72 mm. Calculate: (i) inside clearance (ii) outside clearance and (iii) area ratio of the sampler. [3]

3. a) What do you understand by "General State of Plastic Equilibrium"? How the retaining walls can be proportioned? [3+5]

   b) A 6 m high vertical wall supports a saturated cohesive backfill with horizontal surface. The top 3 m of backfill weighs 18 kN/m^3 and cohesion of 18 kN/m^2. The bulk unit weight and cohesion of bottom 3 m of the wall are 20 kN/m^3 and 25 kN/m^2 respectively. What is the likely depth of tension crack? If the tension crack develops what will be the active earth pressure? Draw the pressure distribution diagram and determine the point of application of the restaurant pressure. [8]

4. What is arching in soil? What are the essential requirements for arching effect to come into play? Describe Terzaghi's arching theory. [1+1+2]

5. What is cofferdam? An excavation of 5 m deep is to be carried out in sandy soil deposit having unit weight = 22 kN/m^3 and angle of shearing resistance = 33°. To support the soil, cantilever sheet pile walls are driven into the ground prior to excavation. Determine the depth of embedment needed for the sheet pile to retain the backfill. The water table is located below the base of the sheet pile. [1+3]

6. a) How do you ascertain whether a foundation soil is likely to fail in local shear or in general shear? Explain the limitations of different classical bearing capacity theories. [2+3]

   b) A circular footing of 2.5 m diameter carries a gross load of 2000 KN. The supporting soil is clayey sand (ϕ=30°, γ=19KN/m^3). Determine the depth at which the footing should be located to provide the factor of safety 3. Use Terzaghi's theory. N_c=37.2, N_q=22.5, N_γ=19.7 for ϕ=30°. [7]

7. Explain about compensated foundation. Describe with neat sketches the various types of mat foundations. [2+4]

8. a) What are the different circumstances under which a pile foundation is used? How is negative skin friction calculated for a single pile and a group of piles in clay? [1+3]

b) A 15 m long closed end steel pipe pile group (3×4) consists of 12 piles of a 300 mm diameter and evenly spaced at 900 mm, center-to-center, is driven into layered undrained clay. The top 6 m consists of clay with undrained cohesion of 50 kPa and adhesion factor of 0.74, followed by 6 m of clay with undrained cohesion of 65 kPa and adhesion factor of 0.62, which was underlain by stiff clay with undrained cohesion of 90 kPa and adhesion factor of 0.50. Estimate the allowable load carrying capacity of pile group. Take factor of safety=2.5. [8]

9. What is a well foundation? Show all components in a neat sketch. Discuss the remedies for tilt and shift of well foundation. [1+4+3]

10. What is stone column? Explain the soil stabilization by use of admixture. [1+3]

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions. ·
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. Classify the shallow and deep foundations according to soil conditions. [2]

2. a) Determine the area ratio of a sampler having external radius of 30 mm and wall thickness of 2.25 mm. Do you recommend this sampler for obtaining undisturbed soil samples and why? [2+1]

   b) List the field tests commonly used in subsurface exploration. What are the corrections that must be applied to the SPT-values for sand before they are used in design charts and empirical correlations? [1+4]

   c) What are the things that you will consider while preparing the site investigation repot? [4]

3. a) Explain the relative wall movements and lateral earth pressure coefficients. How do tension cracks influence the distribution of active earth pressure in purely cohesive soils? Distinguish critically between Rankine's and Coulomb's theories of lateral earth pressure. [2+2+2]

   b) A retaining wall of 7.5 m high has two layers of backfill. The soil supported consists of 5m sand ($\gamma = 18 KN/m^3$, $\phi = 35°$) overlaying saturated clayey soil ($\gamma = 19.5 KN/m^3$, $\phi = 35°$, $C = 16 KN/m^2$). The ground water table is at the upper surface of the clay. Make a sketch of the distribution of the active pressure on the wall stating the principal values. Calculate the total earth thrust per meter of the wall and its point of application. Assume that the backfill is horizontal at the surface. [10]

4. What is arching effect in soils? A long 5 m wide and 10 m high vertical trench has to be constructed in a deep deposit of cohesive soil with $c = 35 kN/m^2$ and $\gamma = 18 kN/m^3$. The safety of the bottom of trench against heave is to be checked before protecting the trench walls using sheet piles. If the excavation to be completed rapidly, determine the factor of safety against bottom heave. What will be the factor of safety if a hard rock is present at 2.5 m from the bottom of the trench? [1+3]

5. What is coffer dam? Describe with neat sketch of the different types of coffer dam. What are the relative merits and demerits of them? [4]

6. a) What are the implications of settlement on structures? Write down the steps of proportioning footings for uniform settlement. [2+4]

   b) A building is to be supported on a reinforced concrete raft covering an area of 14 m × 21 m. The subsoil is clay with an unconfined compressive strength of 14 kN/m². The pressure on the soil due to weight of the building and loads it will carry will be 135 kN/m², at the base of the raft. If the unit weight of excavated soil is 19 kN/m³, at what depth should the bottom of the raft be placed to provide a factor of safety of 3? Use Skempton's bearing capacity formula. [6]

7. Write down the concept of compensated foundation. Describe with sketches the various types of mat foundations.

[1+5]

8. a) What are the various approaches used to estimate the vertical load bearing capacity of a pile? Write causes and effects of negative skin friction in a pile foundation.

[1+4]

  b) A group of 16 piles arranged in a square pattern is to be proportioned in a deposit of soft saturated clay. Assuming the piles to be square with side 30 cm and 12 m long, determine the centre to centre spacing of piles for 100% efficiency of the pile group. Take adhesion factor = 0.8 and consider both point bearing and skin friction.

[7]

9. What are the advantages of well foundations over the other types of deep foundations? Explain about the methods use to rectify tilt and shift of the well foundation with clear sketches.

[2+6]

10. Write down the different methods of soil improvement techniques. Explain sand compaction piles and stone column.

[2+2]

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.		**Back**	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Normal graph paper should be provided.
✓ Assume suitable data if necessary.

1. a) How would you select the suitable type of foundation according to soil conditions? [2]

   b) Why undisturbed samples are required? [2]

2. a) In a core of a Kathmandu valley a Geotechnical investigation is to be carried out. As an engineer recommend the type of drilling and the suitable field tests such that the test data can be used as much as possible. [5]

   b) Prepare an example of borehole log format. [3]

3. a) What mathematical procedures are used in checking the stability of retaining wall? Why are retaining walls usually designed for active earth pressure? [2+6]

   b) A trapezoidal masonry retaining wall 1 m wide at top and 3 m wide at its bottom is 4 m high. The vertical face is retaining soil ($\phi = 30°$) at a surcharge angle of 20° with the horizontal. Determine the maximum and minimum intensities of pressure at the base of the retaining wall. Unit weights of soil and masonry are $20kN/m^3$ and $24kN/m^3$ respectively. Assuming the coefficient of friction at the base of the wall as 0.45, determine the factor of safety against overturning. [8]

4. Explain arching in soils. Explain heave of the bottom of cut in soft clays. [4]

5. Differentiate between rigid retaining structural and flexible retaining structures in terms of stability and deformation analysis. [4]

6. a) Explain how the bearing capacity of soil is affected by the fluctuation of the water table with neat sketch. [6]

   b) Below figure shows the load-settlement curve obtained from a plate load test conducted on a sandy soil. The size of the plate used was 30cm × 30cm. Determine the size of a square column footing to carry a net load of 3200KN with a maximum settlement of 25mm. [8]
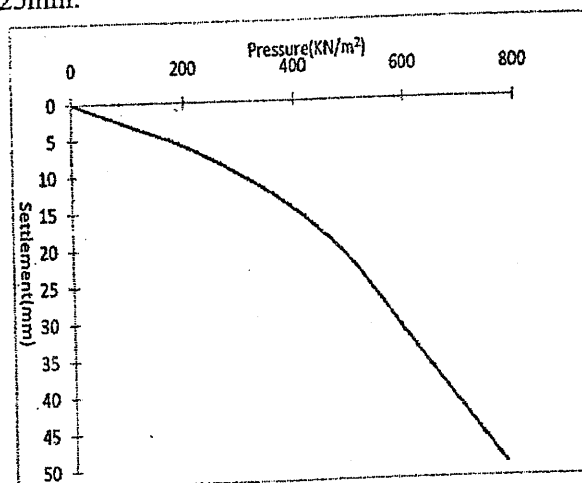

Fig:1 plate load test

7. The 10m × 15m size mat is constructed at 2.5m depth having basement for underground parking. The site consists of highly compressible saturated clay having cohesion of 30 KN/m^2. If the mat carries the total load of 4000 KN. Calculate the factor of safety. [6]

8. a) Elaborate the behavior of single pile differing in its group actions. [4]

   b) A circular pile group of 16 piles penetrates through a unconsolidated soil of 3.5m depth. The diameter of circular pile is 60 cm and pile spacing of 800cm. The average unconfined compressive strength of material is 60 KN/m^2 and the unit weight of soil is 16 KN/m^3. Compute the negative skin friction on the group. Take adhesion factor = 1. [8]

9. Discuss the remedies for tilt and shift of well foundation. Describe with clear sketches the components of well foundations. [3+5]

10. What are the purposes of foundation soil improvement? Explain, in brief, vibroflotation techniques. [2+2]

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

03   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. Mention the factors that should be considered while selecting the foundation. [2]

2. a) What is the physical meaning of area ratio, inside clearance ratio and outside clearance ratio? [4]

   b) Discuss the features of good site investigation report. What are the limitations of plate load test? [5+3]

3. a) What are the conditions to be satisfied while designing a retaining wall? [6]

   b) A retaining wall of 7.5 m high has two layers of backfill. The soil supported consists of 4.5 m sand (γ = 17.5 KN/m^3, ϕ = 300) overlying saturated sandy clay (γ = 19.5 KN/m^3, ϕ = 34°, c = 16.5 KN/m^2). The ground water table is at the upper surface of the sandy clay. Make a sketch of the distribution of the active pressure on the wall. Calculate the total thrust per meter of the wall and its point of application from top of wall. [10]

4. Describe arching of soil. Also describe the step by step procedure of calculating the strut load in case of soft clay with related pressure diagram. [1+3]

5. Find the depth of embedment of 6 m high sheet pile wall retaining the soil having unit weight of 17 KN/m^3 and angle of internal friction of 30°. The water table is at 2 m below the ground level. Also draw the bending moment diagram and solve it by approximate or simplified method. [4]

6. a) Describe different methods to calculate settlement for cohesive and cohesion-less soil. [6]

   b) The 18.3m*30.5m size mat is constructed at 1.52m depth. The site consists of highly compressible saturated clay having a unit weight of 18.87 KN/m^3 and cohesion of 134 KN/m^2. If the mat carries the total load of 111×10^3 KN. Calculate the factor of safety. [6]

7. What is a mat foundation and how is the bearing capacity of mat foundation calculated in case of the cohesive soil? [6]

8. a) Classify the pile foundations according to their material, load transfer and displacement of soil. [4]

   b) A group of 9 piles 10m long and 350mm in diameter, is to be arranged in a square form in a clay soil with an average unconfined compressive strength of 60 KN/m^2. Calculate the center to center spacing of the piles for a group efficiency factor 1. Neglect bearing at the tip piles and take adhesion factor of 0.9. [8]

9. What is the best suitability of well foundation? Showing the clear sketch, explain about different components of well foundation. [2+6]

10. Write down the various methods of improving the shear strength of soil by various soil stabilization methods. [4]

***

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt __All__ questions.*
✓ *The figures in the margin indicate __Full Marks__.*
✓ *Assume suitable data if necessary.*

1. a) Classify the foundations according to their soil condition. [2]

   b) Explain how standard penetration test is carried out in the field. What various corrections are made on the tested value? Describe the nature of sample obtained from the test. [8]

   c) Describe briefly the limitations of plate load test. [4]

   d) Write down the different methods of improving the bearing capacity of weak soils. [4]

2. a) Explain with neat sketch the step by step procedure for Culmann's graphical method of passive earth pressure. [6]

   b) Determine the maximum and minimum pressure under the base of the cantilever retaining wall as shown in figure below and also the factor of safety against sliding and overturning. The approximate shear strength parameters for the soil are c = 0, Φ = 41°. The unit weight of soil and concrete are 16 KN/m^3 and 24 KN/m^3 respectively. The water table is below the base of the wall. Take δ = 27° on the base of the wall. [10]
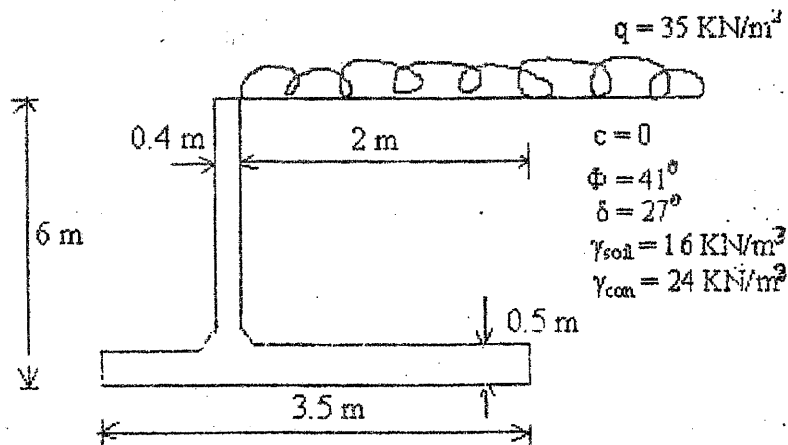
3. a) What is the effect of water table on bearing capacity of soil? A footing was designed based on ultimate bearing capacity arrived for the condition of water table at the ground surface. If there is a chance for raise in water level much above the ground level do you expect any change in the bearing capacity, why? [4]

   b) A circular footing is resting on stiff clay with unconfined compression strength of 250 KN/m^2. Determine the diameter of the footing when the depth of foundation is 2 m and the column load is 700 KN assuming a factor of safety as 2.5, the bulk unit weight of sol is 20KN/m^3. What will be the change in ultimate, net ultimate and safe bearing capacity if the water table is at ground level? [8]

4. a) In what respects does the design of flexible retaining structure vary from rigid retaining structure. [3]

   b) A cantilever sheet pile wall is driven into sand deposit having friction angle 35° and bulk unit weight of 22kN/m³. One side of the sheet pile was backfilled to 3 m height. The backfill material is cohesion less sand having $\Phi = 32°$ and bulk unit weight of 18kN/m³. Using the simplified method determine the depth if penetration needed for the sheet pile to retain the backfill. Provide a safety factor of 2 for the passive resistance. The water table is below the base of the sheet pile. [5]

5. a) What are the conditions where a pile foundation is more suitable than a shallow foundation? What is a negative skin friction? [3+2]

   b) A group of nine piles, 12 m long and 300 mm in diameter is to be arranged in a square pattern in clay with an average unconfined compressive strength of 75 KN/m². Determine the centre to centre spacing of the piles for the efficiency of 1. Neglect the point bearing. [7]

6. a) How do you determine the depth of the well foundation? Describe the process of sinking of well. [4+4]

   b) Describe the procedure of determining the bearing capacity of cohesive cohesion-less soil in case of mat foundation. What is compensated foundations. [4+2]

***

03   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. What are the major criteria to be satisfied in the design of a foundation? [2]

2. a) Differentiate between representative and non-representative soil samples. What are the different sampler design parameters? Explain with their physical meaning (No need to write the formulas) [2+5]

   b) How do you prepare the good site investigation reports? [5]

3. a) What is the earthquake effect on earth pressure? What is the order of horizontal strain required to produce active state in (i) coarse grained soil and (ii) Fine grained soil? What are the tentative dimensions of cantilever retaining walls? [1+2+5]

   b) A retaining wall with a smooth vertical back is 8 m high and retains a 2-layered soil having properties as follows: [8]

Depth (m)	C (KN/m^2)	Φ (degrees)	γ (KN/m^3)
0-4	10	30	18
4-8	0	34	20

   Show the active earth pressure distribution on the back of the retaining wall and its resultant.

4. What are the essential requirements for arching effects? Draw the apparent earth pressure design diagrams recommended by Pecketal (1974) for cuts in sands, firm clay and soft to medium clay. [1+3]

5. What are the different types of cofferdams? What are their relative merits and demerits? [2+2]

6. a) What is the difference among immediate settlements, primary consolidation settlement and secondary compression settlement? Explain the limitations of plate load test. [3+3]

   b) A mat foundation of size 8 m×10 m is resting at a depth of 5 m. The foundation is resting on saturated cohesive soil having undrained cohesion of 50 kPa. The soil has unit weight of 19 KN/m^3. Find the net safe bearing capacity using Skemton's method. [6]

7. What is compensated foundation? Describe the procedure for the conventional design of raft foundations. [2+4]

8. a) Define negative skin friction in pile. Explain a typical situation where negative skin friction may occur. How does negative skin friction affect load carrying capacity of pile? [4]

   b) A pile group consists of 16 piles is driven into a clay deposit. The piles are arranged in square configuration, i.e 4 piles in each direction. The center to center distances between the piles in both directions are 2.4 m. The length of the pile is 10 m and diameter is 0.8 m. The average undrained shear strength along the upper 5 m length of the pile is 40 KN/m^2 and the average undrained shear strength along the lower 5 m length of the pile is 60 KN/m^2. If adhesion factor is 0.6 for both layers, determine the ultimate load capacity of the pile group. [8]

9. Explain with clear sketches the various components of well foundations. What are the different methods to analyze the lateral stability of well foundation? What are the different forces acting on well foundation? [4+2+2]

10. What are the different soil improvement techniques? Explain any two of them. [2+2]

***

06   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	**Full Marks**	80
Programme	BCE	**Pass Marks**	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) What is standard penetration test? Write down its procedure. For what purpose can the result of this test be used? How can the standard penetration values be corrected for dilatancy and over burden pressure? [8]

   b) Explain Terzaghi's trap door experiment with neat sketch. A 8 m deep cut in sand with a cut width of 5 m is braced at equal distance of 2 m from the surface at three locations. In the plan the struts are placed at a spacing of 4 m center to center. Using empirical pressure diagram, calculate the design strut loads if the properties of sand is, angle of shearing resistance of 30° and unit weight of 16 kN/m³. [8]

2. a) High steel sheet pipe wall with smooth vertical back supports a dry cohesionless soil that weighs 18 kN/m³. The backfill rises from the crest of the wall at an angle of 20° with the horizontal. If the angle of internal friction of backfill materials is 30°, determine the magnitude and point of application of active earth pressure per meter length of the wall. What will be the change in its magnitude and point of application, if water tables rises to an elevation of 2 m below the top of the wall? Take the submerged unit weight of the backfill material as 12kN/m³. [8]

   b) Describe Culmann's graphical method of finding earth pressure for active state and explain how surcharge will affect earth pressure in active states. [8]

3. a) How do you differentiate whether there will be general or local shear failure at your site? An engineer wants to construct a circular footing of 1 m diameter to transfer the load of 1000 kN with the safety factor of 2.5 to a soil strata with an angle of shearing resistance 30°, cohesion 10kN/m² and unit weight of 18 kN/m³. Suggest the engineer what should be the depth of the footing. Take Terzaghi's bearing capacity factors Nc, Nq and Nγ as 37.2, 22.5 and 19.7 respectively. [4+8]

   b) A mat 18m×22m in plan has its base 3 m below the surface of the deposit of clay with a unit weight of 20 KN/m³. The unconfined compressive strength of clay is 75 KN/m². The factor of safety against bearing capacity failure must be 3. Determine total weight of building plus the foundation the raft can safety support. [4]

4. a) Give a method to determine the bearing capacity of a pile in sandy soil. What is group effect and how will you estimate the capacity of a pile group in sand with neat sketch? Explain the application and limitations of pile load test. [10]

   b) A group of 16 piles of 50 cm diameter is arranged with a center to center spacing of 1.0 m. The piles are 90 m long and are embedded in soft clay with cohesion of 30 kN/m². Bearing resistance may be negelected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group. Also check the efficiency of the group of pile. [6]

5. a) What are the conditions that demand the improvement of the soil? Write down the different methods of soil improvement techniques. Write down the measures to be taken for sinking the wells and correcting the tilts and shifts occurred during sinking of caissons. [2+2+4]

   b) Determine the depth of embedment and force in tie rod of an anchored sheet pile wall retaining soil bank of height 5 m. The tie rod is located 1 m below the top of the wall. The backfill and the soil below the drege line in cohesionless. Take φ = 30° and soil unit weight as 18kN/m³. [8]

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. What are the factors influencing the choice of foundation? What type of information should be obtained in reconnaissance? Write down different types of exploration method.   [6]

2. Explain and discuss the various factors that help decide the number and depth of bore holes required for subsoil exploration. Describe the methods of soil sampling.   [8]

3. a) Explain, how the effect of wall movement directs the type of earth pressure in designing the retaining walls?   [6]

   b) A rigid retaining wall of 6 m height has two layers of backfill. The top layer to a depth of 1.5 m is sandy clay having $\phi = 20°$, C = 12 KN/m² and $\gamma = 16.4$ KN/m³. The bottom layer is sand having $\phi = 30°$, c = 0 and $\gamma = 17.25$ KN/m³. Determine the total active earth pressure acting on the wall and draw the pressure distribution diagram.   [8]

4. What is arching in soil? What are the essential requirements for aching effect to come into play?   [4]

5. Determine the maximum bending moment on the cantilever sheet pile supporting a cohesionless backfill ($\phi = 30°$, $\gamma = 18$ KN/m³) of height 9m. The water level is on both sides of the sheet pile and above 4 m from the dredge level.   [4]

6. a) Describe the various methods to estimate the settlement in cohesioless soil with the help of necessary sketches and graph.   [6]

   b) A strip footing of 1.5 m width with its base at a depth of 1.2 m is resting on dry sand. The water table is 1 m below the base of footing. Find the change in the ultimate bearing capacity of footing if the water table rises up to the depth 0.5 m below the ground level. Take N_c=95.7 N_q = 81.3, N_y = 100.4, G = 2.70 and dry unit weight of sand as 16 KN/m³.   [10]

7. What is the condition that demands the need of mat foundation? How can its settlement be estimated?   [6]

8. a) Give a method to determine the bearing capacity of a pile in clay soil. What is group effect and how will you estimate the capacity of a pile group in clay?   [5]

   b) A group of 9 piles with 3 piles in a row was driven into a soft clay extending from ground level to a great depth. The diameter and the length of the piles were 30 cm and 10 m respectively. The unconfined compressive strength of the clay is 70 kPa. If the piles were placed 90 cm center to center, compute the allowable load on the pile group on the basis of a shear failure criteria for a factor of safety of 2.5.   [5]

9. Mention the sinking procedure of the well in foundation. Also, describe the grip length and scour depth.   [8]

10. Write down the different steps involved in the process of soil stabilization using cement as the additive.   [4]

***

03r   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. What are the general requirements of building foundation? What are the points that should considered while preparing the site investigation report? [2+4]

2. In a core of Kathmandu valley a Geotechnical investigation is to be carried out. As an engineer, recommend the type of drilling and the suitable field tests such that the test data can be used as much as possible. [7]

3. a) Describe the step by step procedure of Culmann's graphical method to determine the active thrust behind the retaining wall supporting the cohesionless backfill carrying the concentrated line load. [6]
   b) Explain the differences between the Rankine's and Coulomb's earth pressure theory. Determine 'At rest pressure' and its point of application for the following case. Take the unit weight of soil and angle of internal friction above and below water tables as $17KN/m^3$ and $20KN/m^3$, $30°$ and $33°$ respectively. [3+6]
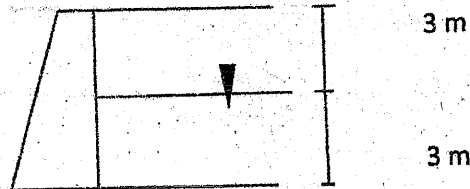

4. What are the bracing systems in braced excavations? Explain deep cuts in soil. [4]

5. What is a cofferdam? Write down the methods of its application. [4]

6. a) Explain how the bearing capacity of soil is affected by the fluctuation of the water table with neat sketch. [6]
   b) A footing 3 m × 4 m in plan is to be laid at a depth of 1.5 m below ground surface to carry a column load having one way eccentricity of 0.26 m along x direction. Determine the safe bearing capacity if water table is 0.5 m below the ground level. Use Terzaghi's theory. Take $\phi = 29°$, $C = 20 KN/m^2$, $N_c = 50$, $N_q = 42$ and $N_\gamma = 46$. [10]

7. What are the common types of mat foundation? Write down the concept of compensated foundation. [6]

8. a) Derive the relation for determining the pile load carrying capacity of driven pile in sand by static method. [5]
   b) Differentiate the following: [2×3]
      i) Batter pile and Tension pile
      ii) Individual failure and block failure
      iii) Drop hammer and steam hammer

9. What is a well foundation? Show all components in a neat sketch. Discuss the remedies for tilt and shift of well foundation. [7]

10. Mention the uses of soil stabilization and describe any one method of soil stabilizations. [4]

***

Exam.		New Back (2066 & Later Batch)	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Identify the factors influencing the choice of foundation? What are the things that you will consider while preparing the site investigation report? [2+4]

2. Explain the procedure of standard penetration test. [8]

3. a) A retaining wall with smooth vertical back retains sand backfill for a depth of 6 m. The backfill has horizontal surface and has following properties $C = 0$, $\phi = 28°$, $Y = 16$ kN/m², $Y_{sat} = 20$ kN/m³. Calculate the magnitude of total thrust against the wall if backfill is fully drained, but the top of wall is restrained against yielding. [10]
   b) What mathematical procedure is used in checking the stability of retaining wall? [6]

4. a) Determine the loads on the 3 struts as shown in the following figure. The soil is clay having properties of $c = 40$ KN/m² and $Y = 19$ KN/m³. The spacing of the struts along the length of cut is 2.50 m. [4]
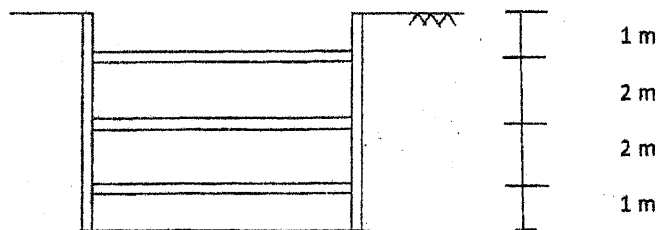

   b) What are the conditions that demand the construction of coffer dams? Write about the cantilever sheet pile wall. [4]

5. a) What are the possible types of foundation settlement? Explain sand compaction piles. [2+2]
   b) Determine the allowable bearing capacity of the foundation of size 3 m of square shape from the plate load test data given below with the test plate of thickness 25 mm and size 60 cm. The sub soil consist of moist medium to coarse sand. [8]

Load (kg)	500	1000	2000	3000	4000	5000
Settlement (cm)	0.18	0.37	0.75	1.8	5.0	18

6. a) How the behavior of single pile differs in its group actions? Explain the procedures involved in the determination in the strut loads in braced cut. [2+4]
   b) Design a friction pile group to carry a load of 3000 KN including the weight of pile cap, at site where the soil is uniform clay to a depth of 20 m, underlain by rock. Average unconfined compressive strength of clay is 70 KN/m². Take factor of safety of 3 and adhesion factor 0.4. [6]

7. What are the common type of mat foundation used in civil engineering work? [6]

8. a) Describe the various components of well foundation with neat sketch. [4]
   b) A circular well of 6 m external diameter and 4 m internal diameter is embedded to a depth of 15 m 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 tilt is about a point above the base. Take $Y_{sat} = 20$ KN/m³, $\phi = 30°$ and factor of safety for passive resistance = 2.0. [4]

9. What are sand compaction piles and stone column used for? Write its importance. [4]

***

oo   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. How do you select the type of footing? Describe preloading in detail. [2+4]

2. What is pressure meter test (PMT)? How it is carried out in the field? [8]

3. a) Check the stability of the retaining wall shown below with the following given parameters. Unit weight of the concrete is 25 KN/m³, $\gamma = 18$ KN/m³, $\gamma_{sat} = 20$ KN/m³, $\gamma_w = 10$ KN/m³, $\phi = 30°$, $\delta = 2\ \phi/3$, the ultimate bearing capacity of soil is 550 KN/m². [10]
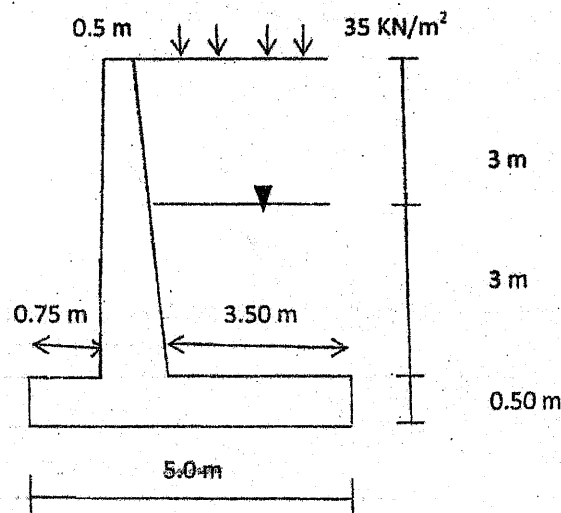
   b) Explain the trial wedge method for determining the active earth pressure with net sketch. [6]

4. a) Why arching in soil is important? Write down the assumption made by cain's theory. [4]

   b) A 2.5 m deep excavation of trench is carried out in sand and supported by cantilever sheet pile wall. The water table is at both sides of sheet pile wall is found at bottom of excavation, $\gamma_{bulk} = 18$ KN/m³, $\gamma_{sat} = 20$ KN/m³, $\phi = 35°$, factor of safety for passive resistance is 2. Determine the required depth of embedment of sheet pile. [4]

5. a) How does water table influence the bearing capacity of soil? Explain with sketch. [4]

   b) A square footing is designed to carry a load of 4500 KN. If the depth of foundation is 3 m. Determine the suitable size of foundation. The water table is at 0.8 m below ground level. Use Terzaghi's theory, take $\phi = 25°$, $\gamma = 16$ KN/m³, $\gamma_{sat} = 19$KN/m³, $N_c' = 14.8$, $N_q' = 5.6$, $N_\sigma' = 3.2$, $C = 20$ KN/m³. [8]

6. a) Derive the static pile load formula for the driven pile. [6]

   b) A group of 9 piles, 12 m long and 250 mm in diameter is to be arranged in a square form in a clay soil with an average unconfined compressive strength of 60 KN/m². Work out the center to center spacing of the piles for a group efficiency factor of 1.0. Neglect bearing at the tip of the piles. Take adhesion factor as 0.90. [6]

7. Explain compensated foundation and is it possible to construct a fully compensated foundation. [6]

8. Describe well foundation with a neat sketch. At what circumstances well foundation is proposed? [6+2]

9. What are the different method of improving the bearing capacity of weak soil. [4]

***

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. What are the different types of foundations? [2]

2. a) How would you decide the depth of exploration and the lateral extent of the investigation? [4]

   b) What is pressure meter test (PMT)? How is it carried out in the field? [8]

3. a) Explain the trial wedge method for determining the active earth pressure with neat sketch. [8]

   b) A retaining wall 6 m high, vertical back, supports a saturated clay soil with a horizontal surface. The properties of the back fill are: $\phi_u = 0$, $C_u = 35 kN/m^2$ and $\gamma = 17 kN/m^3$. Assuming the back of the wall to be smooth, determine: the total active thrust against the wall and its point of application. [8]

4. Why arching in soil is important to be studied in geotechnical engineering? Explain the different theories that have been classified by Terzaghi. Derive the expression of finding depth of dredge for cantilever sheet pile using simplified method. [4+4]

5. a) What are the principles differences between Prandtls's bearing capacity theory and Terzaghi's bearing capacity theory? [4]

   b) A square footing is to be designed to carry a load of 6000KN. If the depth of foundation is 2m, determine the suitable size of foundation. The water table is at 0.8 m below ground level. Use Terzaghi's theory. Take $\phi = 25°$, $\gamma = 16\ KN/m^3$, $\gamma_{sat} = 19\ KN/m^3$, $C = 20\ KN/m^2$, $N_c = 14.8$, $N_q = 5.6$, $N_\gamma = 3.2$. [8]

6. The 20 m × 30 m size mat is constructed at 3.5 m depth having basement for underground parking. The site consists of highly compressible saturated clay having cohesion of 30 KN/m². If the mat carries the total load of 5700 KN. Calculate the factor of safety. [8]

7. What is laterally loaded pile? A circular pile group of 16 piles penetrates through a unconsolidated soil of 3.5 m depth. The diameter of circular pile is 60 cm and piles spacing 800 cm. The average unconfined compressive strength of the material is 60 KN/m² and the unit weight of soil is 16 KN/m³. Compute the negative skin friction on the group. Take adhesion factor = 1. [2+8]

8. What is a wall foundation? Write down the operation involved in sinking the well foundation. [8]

9. Write down the different methods of improving the bearing capacity of weak soils. [4]

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering *(CE602)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. List out the factors affecting the type of foundation. [2]

2. a) What are the different types of sampler to obtain undisturbed soil samples? Describe any one procedure of obtaining undisturbed sample. [6]

 b) Explain and discuss the various methods of boring required for subsoil exploration. [6]

3. a) Derive an expression for the determination of factor of safety against bottom heave in a soft clayey soil. [8]

 b) A 6 m high retaining wall supports 5 m sand ($\gamma = 18$ KN/m^3, $\phi = 30°$, C = 0) overlying saturated sandy clay ($\gamma = 19.5$ KN/m^3, $\phi = 36°$, C = 16 KN/m^2). The ground water level is at the upper surface of sand. Determine the Rankine's active force per unit length of the wall and the location of the thrust, assuming that the retaining wall can yield sufficiently to develop an active state. [8]

4. What are cofferdams? Write their significance. How can the earth pressure against bracing in cuts be determined? [8]

5. a) What is the effect of water table on bearing capacity of soil as per Terzaghi's general bearing capacity equation for local shear failure? [4]

 b) A 1.8 m square column in foundation at a depth of 1.8 m in sand, for which the corrected N-value is 24. The water table is at a depth of 2.7 m. Determine the net allowable bearing pressure for a permissible settlement of 40 mm and a factor of safety of 3 against shear failure. [8]

6. What are the different types of mat foundation? How can the bearing capacity be determined for the mat foundation? [8]

7. What are the functions of pile foundation? Determine the group efficiency of a rectangular group of piles with 4 rows, 3 piles per row, the uniform pile spacing being 3 times the pile diameter. If the individual pile capacity is 100 KN, what is the group capacity according to this concept? [2+8]

8. How will you decide the depth of well foundation? Describe the possible techniques to eliminate the tilt and shift of well during sinking. [8]

9. What do you mean by preloading? Mention the advantage of preloading and at which condition do you refer? [4]

***

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Foundation Engineering (CE 602)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **all** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What is an undisturbed sample of soil? Describe, how you can obtain undisturbed sample from the site. [2+6]

   b) Describe the major advantages and disadvantages of Pressuremeter Test over the other methods of soil exploration. Mention the key points that should be considered to perform the Pressuremeter Test at a particular site. [3+5]

2. a) What are the differences between Coulomb's theory and Rankine's theory of earth pressure? Describe the effect on wall movement on earth pressure. [4+4]

   b) A cut 3.5m wide, 7m deep is proposed in a cohesionless deposit ($\varphi = 35°$). Assuming the first row of struts to be located at 0.6m below the ground surface and spacing between struts as 2m, calculate the maximum strut load. Assume the horizontal spacing of struts as 3.5m, $\gamma = 21 kN/m^3$ and $\delta = 15°$. [8]

3. a) What are the theories on the bearing capacity of soil? Derive the expression for ultimate bearing capacity of soil as per Terzaghi's analysis. [1+7]

   b) The sides of an excavation 3m deep in sand are to be supported by cantilever sheet pile walls. The water table is 1.5m below from the bottom of excavation. The sand has saturated unit weight of $20 kN/m^3$ and unit weight of $17 kN/m^3$ above the water table and $\varphi = 36°$. Determine the depth of penetration of the piling below the bottom of excavation to give a factor of safety of 2.0 with respect to passive resistance. [8]

4. a) What is negative skin friction? Describe the circumstances on which pile foundation has to be selected. Also describe the selection procedure of pile type. [2+3+3]

   b) A footing of 2m × 3m in plan is founded 1.5m below the ground level in clay having angle of repose = 36°, c = 10kPa, what will be the allowable load which can be carried by the footing if the load is eccentrically applied with eccentricity along X and Y direction as 0.25m and 0.35m respectively. The centre of footing in plan is taken as origin. The water table is located 1m below the ground level. Assume soil above water table is as dry. Take dry and saturated unit weight of clay as $16 kN/m^3$ and $20 kN/m^3$ respectively. Take $N_c = 50$, $N_q = 42$ and $N_\gamma = 46$. [8]

5. a) Is it necessary to analyse the lateral stability of well foundation? If so, describe why and how it is to be carried out. [2+6]

   b) A RCC pile weighing 41.2 kN(including weight of helmet and dolly) is driven by drop hammer weighing 49kN and having an effective fall of 1m. The average settlement per blow is 14mm. The total elastic compression is 12mm. Assuming the coefficient of restitution as 0.2 and FOS as 2.5, calculate the ultimate load and allowable load for the pile. [8]
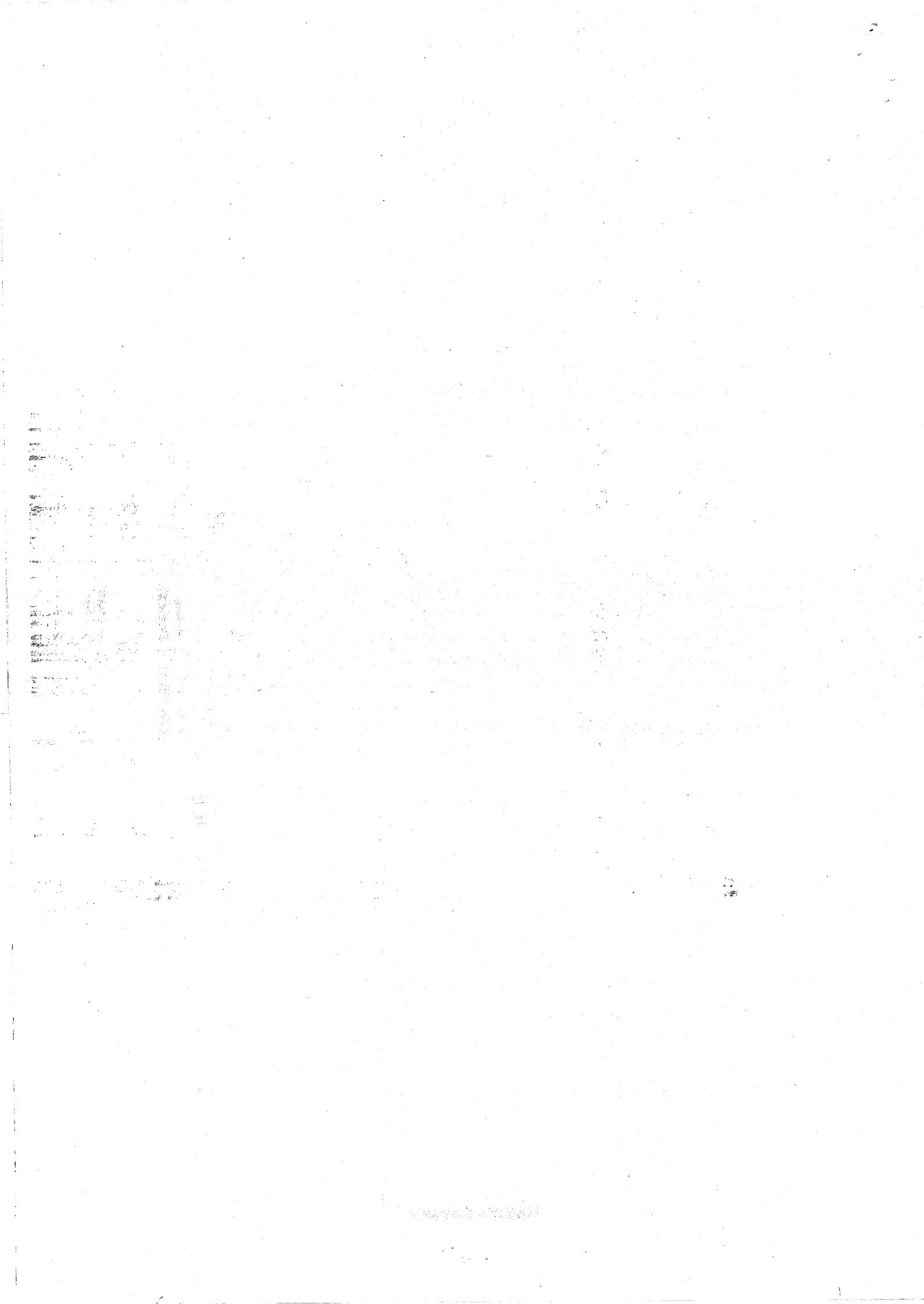
***

Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What are the various steps considered in the planning of sub-surface exploration programme? Describe the standard penetration test. In what way is it useful in foundation design? [3+4+1]

   b) A SPT was performed at a depth of 20m in a dense sand deposit with a unit weight of 17.5kN/m^3. If the observed N-value is 48, what is the N-value corrected for overburden and dilatency? The inner diameters of a sampling tube and that of a cutting edge are 70mm and 68mm respectively, their outer diameters are 72 and 74mm respectively. Determine the inside clearance, outside clearance and area ratio of the sampler. [4+4]

2. a) 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 above the top horizontal surface of wall. The unit weight of sand is 18kN/m^2 and $\phi = 30°$. Find the maximum and minimum pressure at the base of the wall assuming the unit weight of masonry as 23kN/m^3. [8]

   b) Describe Culmann's graphical method of finding earth pressure for active and passive cases. Assume sloping surface above the top horizontal surface of wall. [8]

3. a) What are the assumptions made in Terzaghi's analysis of bearing capacity of a continuous footing? Bring out clearly the effect of ground water table on the safe bearing capacity above, below and at the base of foundation. [4+4]

   b) A footing, 2m square, is founded at a depth of 1.5 m in a sand deposit, for which the corrected value of N is 27. The water table is at a depth of 2m from the surface. Determine the net allowable bearing pressure, using both Teng's and Bowles' empirical relationships, if the permissible settlement is 40mm and a factor of safety of 3 is desired against shear failure. [8]

4. a) Derive a method to determine the bearing capacity of a pile in C and ϕ soil. What is group effect and how will you estimate the capacity of a pile group in C and ϕsoil, explain with neat sketch? Explain the application and limitations of pile load test. [3+4+3]

   b) A 30cm square pile, 15m long, is driven in a deposit of medium dense sand ($\varphi = 36°$, $N\gamma = 40$ and $Nq = 42$). The unit weight of sand is 15kN/m^3. What is the allowable load with a factor of safety of 3? [6]

5. a) What is a pier foundation? Explain the different types of caissons with their advantages and disadvantages. Describe the different parts of well foundation with neat sketch. [1+3+4]

b) A building is supported symmetrically on four columns, spaced at 4.5m c/c. At the chosen depth of 2m, the allowable bearing capacity is 300 kN/m^2, $\gamma = 18$kN/m^3.Proportion the footings for equal settlement. The column loads are given below: [8]

Column No.	1	2	3	4
DL(kN)	200	350	250	270
LL(kN)	200	400	200	270

6. a) Discuss the different methods of improving the bearing capacity of weak soils. Describe the different steps involved in the process of soil stabilization using cement as the additive. [8]

b) Determine the depth of embedment of an anchored steel pile wall using free earth support method in a deposit of sand having C = 0, $\phi = 32°$, $\gamma_{sat} = 22$kN/m^3 and $\gamma_{dry} = 17$kN/m^3. The water table is 2m below the ground surface. The height of the wall above the dredge line is 3m. Use simplified method. [8]

***

Exam.		Regular / Back		
Level	BE	Full Marks	80	
Programme	BCE	Pass Marks	32	
Year / Part	III / II	Time	3 hrs.	

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Site investigation has to be done for a two lane bridge to be constructed in Kathmandu valley. The client seeks the value of bearing capacity and settlement of the foundation for the bridge. What method of site investigation and in-situ tests would you advise as a project engineer? Explain the in-situ tests you have advised in detail. [8]

   b) Discuss the various factors that help to decide the number and depth of bore holes required for subsoil exploration. What is 'N- value' of standard penetration test? How do you determine relative density from 'N-value'? Explain the various corrections to be applied to the observed value of N. [3+1+2+2]

2. a) A retaining wall 12 meter high is proposed to hold sand. The values of void ratio and φ in the loose state are 0.63 and 30° while they are 0.42 and 40° in the dense state respectively. Assuming the sand to be dry and that its grain specific gravity is 2.67, compare the values of active and passive earth pressures in both the loose and dense states. [8]

   b) Compare the Rankine's theory with the Coulomb theory in respect of [8]
      i) Idealization of soil
      ii) State of the soil mass during active and passive pressure development
      iii) Rupture surface
      iv) Backfill surface

3. a) Discuss the various factors that affect the bearing capacity of a shallow footing. How do you ascertain whether a foundation soil is likely to fail in local shear or in general shear? What are the modifications proposed by Terzaghi in his bearing capacity equation for local shear failure? [3+3+2]

   b) A strip footing is to be designed to carry a load of 1000KN/m at a depth of 1m in gravelly sand. The angle of internal friction of the soil is 40°. Determine the width of the footing if a factor of safety of 3 against shear failure is specified and assuming that the water table may rise to foundation level. Above the water table the unit weight of the sand is 17KN/m^3 and below the water table the saturated unit weight is 20KN/m^3 for θ = 40°, Nγ = 95, Nq = 64. [8]

4. a) What are the different circumstances under which a pile foundation is used? Classify pile foundation on the basis of [2+6]
      i) Material
      ii) Load transfer
      iii) Method of installation

b) A square pile group of 16 piles passes through a filled up spil of 3 m depth. The pile diameter is 25 cm and pile spacing is 75cm. If the unit cohesion of the material is 18KN/m^2 and unit weight is 15 KN/m^3, compute the negative skin friction on the group. [8]

5. a) What is a Caisson foundation? Explain the different types of caisson foundation with neat sketch. Explain the construction activities involved during construction of a pier foundation. [1+3+4]

b) A cantilever retaining wall is to be constructed to retain a sand backfill. Using following data: height of backfill above grade = 5.5m, β = 10°, θ = 38°, γ = 17.5KN/m^3, determine the tentative proportions of cantilever retaining wall. Assume a depth of embedment as 1.5m. [8]

6. Write short notes on: [4×4]

   a) Types of cofferdams with neat sketch
   b) Different methods of drawing down the water table for excavation with neat sketch
   c) Classification of foundation according to their use and applicable soil conditions
   d) Component parts of well foundation

***

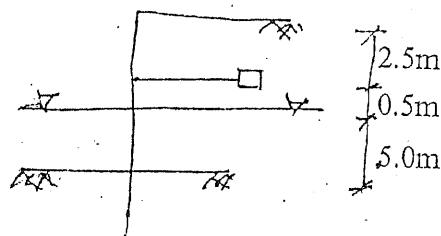| Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any Five questions.*
✓ *The figures in the margin indicate Full Marks.*
✓ Assume suitable data if necessary.

1. a) Describe Culmann's graphical method for determination of active thrust exerted on the back of the retaining wall by cohesionless soil. [8]

   b) Determine the Rankine's active force per unit length of the following wall. [8]
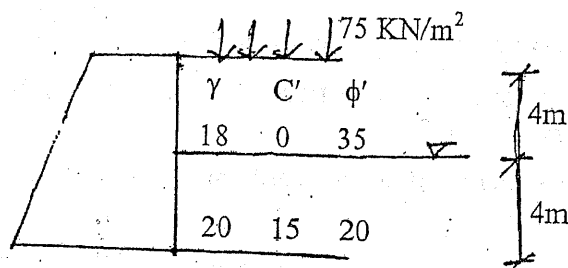
2. a) Describe the various ways of classifying piles. [10]

   b) A friction pile 300mm diameter is proposed to be driven in a layer of uniform cohesive soil having shear strength of 40 KN/m^2. The adhesion factor between soil and pile material is 0.7. Neglecting base resistance, determine the length of pile required to carry a safe load of 200 KN with factor of safety of 2.5. [6]

3. Explain any four: [4×4]

   a) Proportion of footing for uniform settlement
   b) Types of raft foundation
   c) Construction of pier by Chicago method
   d) Difference between pier and caisson
   e) Negative skin friction

4. a) Describe wash boring with neat sketch. [6]

   b) Explain the procedure of standard penetration test. [10]

5. a) Describe the factors that affect bearing capacity. [6]

   b) A square footing is required to carry a net load of 1200 KN. Determine size of footing if the depth of footing is 2m. The soil is sandy with N = 12. The water table is very deep. Use Terzaghi's equation and the footing is not allowed to settle more than 40mm. [10]

6. a) Explain the uses of sheet pile with sketch. [4]

   b) Determine the depth of embedment of the given anchored sheet pile by free earth support method. Also determine force in Anchor per meter of the wall. Take $\gamma = 16$ KN/m^3, $\gamma_{sub} = 9$ KN/m^3, $\phi' = 35°$, $C' = 0$. Use simplified method. [12]

02R   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Chaitra

Re - Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five questions.*
✓ The figures in the margin indicate *Full Marks.*
✓ Assume suitable data if necessary.

1. a) How do you carry out drilling work by wash boring? [8]

   b) Describe various types of shallow foundation. Where and why you use strap footing. Describe with necessary sketches? [8]

2. a) Describe how the co-efficient of active earth pressure is obtained for a sloping backfill comprising of sand. [8]

   b) A toe wall is 5.5m high. The soil supported consists of 5m sand ($\gamma = 18$ KN/m^3, $\phi = 35°$) overlying saturated sandy clay ($\gamma = 19.5$ KN/m^3; $\phi = 30°$, C = 16 KN/m^2). The ground water level is at upper surface of the sandy clay. Make a sketch of the distribution of the active pressure on wall stating the principle values. Calculate the total thrust per meter length of the wall and its point of application. Assume that the top of backfill is horizontal. [8]

3. a) Define net allowable bearing capacity? What is meant by 'SPT value'? How can we obtain 'SPT value'? Describe its importance on computation of bearing capacity? [1+2+3+2]

   b) A square footing is to be constructed at a depth of 3.6m below ground level on a sandy clay for which the cohesion 'C' is 0.575 kg/cm^2 and the density is 1.73 g/cm^3. The total load applied on the soil is 375 tonnes uniformly distributed over the area of contact. Find the size of the footing, using Terzaghi's formula for net ultimate bearing capacity, where FS = 3, $N_C = 10$, $N_q = 4$, $N_r = 2$. [8]

4. a) How the spread footing is designed on firm soil above soft layers? Describe critically? [8]

   b) A cantilever sheet pile wall is driven into sand deposit having friction angle 30° and bulk unit weight of 22 KN/m^3. One side of sheet pile was backfilled to 3m height. The backfill material is cohesionless and having friction of 32° and bulk unit weight of 18 KN/m^3 using the simplified method determine the depth of penetration needed for the sheet pile to retain the backfill. Assume necessary data. [8]

5. a) Describe how to be drained a soil at a given site by multistage well point. To what depth this method can use effectively. What method to be suggested for drainage a site which cannot be done by multistage well point? [6+1+1]

   b) Design a friction pile group to carry a load of 235 KN including the weight of the pile cap for a site where the soil is uniform clay to a depth of 20m underlain by rock. Average unconfined compressive strength of the clay is 100 KN/m^2. Take factor of safety 3 and N_C as 9. [8]

6. Write short notes on: [4×4]

   a) Difference between Peir and Caisson
   b) Terzaghi's earth pressure theory
   c) Cofferdams
   d) Component parts of a well foundation

***

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ *All* questions carry equal marks.
✓ Assume suitable data if necessary.

1. a) Describe with sketches the various types of shallow foundations. Explain under what circumstances they are used. [4+4]

   b) What is sampling? Describe the method of obtaining a hand carved sampling. [2+6]

2. a) How does an activate state of earth pressure differ from passive state? Derive an expression for passive earth pressure by using Rankine's Theory to solve the problem of inclined surface of backfill. [2+6]

   b) A vertical excavation was made in a clay deposit having unit weight of 20 kN/m^3. It caved in after the depth of digging reached 4 meters. Taking the angle of internal friction to be zero, calculate the value of cohesion. If the same clay is used as a backfill against a retaining wall, up to a height of 8 meters, calculate (i) total active earth pressure (ii) total passive earth pressure. Assume that the wall yields for enough to allow Rankine deformation conditions to establish. [8]

3. a) Discuss the various factors that affect the bearing capacity of shallow footing. Write in brief the critical notes on settlement of foundations. How do you ascertain whether a foundation soil is likely to fail in local shear or in general shear? [2+4+2]

   b) A rectangular footing 3m by 4m is placed at 1.5 m depth in cohesionless sand having angle of shearing resistance of 34^0 and a unit weight of 20 kN/m^3 (above and below ground water). Determine the safe load that can be carried by the foundation for a safety factor of 3.0 if the excavation is backfilled and
   (i) The water table is at 1m below the ground surface.
   (ii) The water table is at 1m below the base of foundation.
   The bearing capacity factors for strip footing for $\phi = 34^0$ are $N_q = 29$ and $N_\gamma = 41$. [8]

4. a) A construction site consists of two stratification of soil. The dense or stiff layer is overlying soft deposit. Describe in brief, how can you design the spread footing under such situation? Explain the condition at which shallow foundation is replaced by deep foundation. [6+2]

   b) A trapezoidal masonry retaining wall 1 m wide at top and 3 m wide at its bottom is 4 m high. The vertical face is retaining soil having angle of shearing resistance of 30^0 and the back fill is sloping at an angle of 20^0 with horizontal. Determine the maximum and minimum intensities

of pressure at the base of the retaining wall. Unit weight of soil and masonry are 20 kN/m^3 and 24 kN/m^3 respectively. Assuming the coefficient of friction at the base of the wall is 0.45, determine the factor of safety against sliding. Also determine the factor of safety against overturning. [8]

5. a) Define pile foundation. Mention types of pile load test. Describe in brief with neat sketches the construction techniques of <u>driven and cast in place</u> pile. [1+1+6]

   b) In a pile group, 25 piles are arranged in a uniform pattern in a soft clayey soil with equal spacing in all directions. Determine the optimum value of the spacing. Neglect the end bearing effect and take the adhesion factor 0.7. Assume that each pile is circular section and take average undrained cohesion of 18 kN/m^2. [8]

6. a) A soil investigation report on the building project site reveals the soil having very low bearing capacity. What could be your opinion in this regard? How can you stabilize and improve the bearing capacity of such soil from suitable geotechnical processes? [8]

   b) An excavation of 4 m deep is to be carried out in a cohesionless sand deposit. To support the soil, cantilever sheet pile walls are driven into the ground prior to excavation. The ground water table is located at 2.0 m from top of the supporting soil. The bulk unit weight of the sand is 18 kN/m^3 above the water table and 21 kN/m^3 below the water table. The friction angle is 30^0. The soils below the water table and below the dredge line have similar properties. Determine the required depth of embedment by using simplified method. [8]

Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Foundation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any Five questions.*
✓ *The figures in the margin indicate Full Marks.*
✓ *Assume suitable data if necessary.*

1. a) Describe various factors that effect foundation selection. Explain the step by step procedure for the selection of a suitable in a given situation.

   b) Differentiate between disturbed and undisturbed samples. Describe in brief the sampling procedure for undistributed samples. Furnish your answer with neat sketches. [3+5]

2. a) What are the basic differences between Coulomb and Rankine's earth pressure theories? Derive an expression of active lateral pressure using Rankine's theory for (c, ϕ) soils. [2+6]

   b) A 4m high earth retaining structure having vertical back is backfield with cohesionless soil of $\phi = 30°$ and $\gamma = 18$ kN/m^3. The surface of the backfill is horizontal on which a uniform surchage of 10 kN/m^2 is laid. Using Rankine's earth pressure theory determines the active lateral thrust if the water table is 2m above the base of the wall. Determine also the direction and position of thrust measured from the base of the wall. [8]

3. a) Differentiate between general shear failure and local shear failure. What are the assumptions made in the direction of Prandtl bearing capacity theory? What are the limitations in the bearing capacity equation suggested by Prandtl? [3+3+2]

   b) A footing 1.5m diameter carries a load of 800 kN. The soil (c = 0) has an angle of internal friction of 36° and unit weight of 18 kN/m^3. What will be the depth of foundation, if factor of safety = 2.5? For $\phi = 36°$, $N_q = 38$ and $N_\gamma = 41$. [8]

4. a) Describe the procedure for proportioning spread footings for uniform settlement. [8]

 b) Check the stability of the cantilever retaining wall shown in figure below against bearing failure, sliding and overturning. Take the unit weight of the soil as 16 kN/m^3 and that of the concrete as 25 kN/m^3. Also take $\phi = 35°$, c = 0, coefficient of friction 0.4, and a safe bearing capacity of 18 kN/m^2. [8]
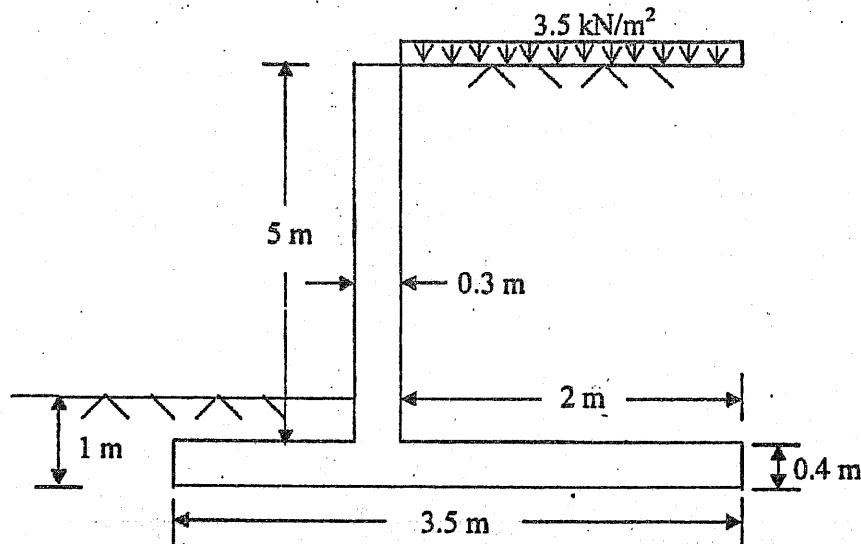
5. a) Define pile foundation. Describe the classification of piles based on the materials and mode of transfer of loads. Explain in detail, the types of pile load tests. [1+3+4]

 b) Design a friction pile group to carry a load of 3000 kN including the weight of pile cap at a site where the soil is uniform clay to a depth of 20m underlain by rock. Average unconfined compressive strength of clay is 70 kN/m^2. Take factor of safety of 3 and adhesion factor 0.4. [8]

6. a) Explain the conditions that are suitable for the selection of caisson foundation. Briefly explain the different types of caisson foundation. Furnish your answer with neat sketches. [3+5]

 b) A 4m deep excavation of a trench is carried out in sand and supported by cantilever sheet pile wall. The water table at both sides of the sheet pile wall is found at the bottom of the excavation. The bulk unit weight of the sand is 20 kN/m^3 above the water table and 22 kN/m^3 below the water table. The angle of internal friction of sand both below and above water table is 30°. Determine the required depth of embedment by using simplified method. [8]

***