SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE
SEMBODAI - 614809

BACHELOR OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

Sub.Code: CE6405 **Branch/Year/SEM: CIVIL/II/ IV**

Sub.Name: Soil Mechanics **Batch: 2014-2018**

Staff Name: M.Anbarasan B.E., **Academic Year: 2014-2016(EVEN)**

UNIT-I: SOIL CLASSIFICATION AND COMPACTION

PART – A

1. Distinguish between Residual and Transported soil
2. Give the relation between γ_{sat}, G, γ_w and e.
3. A compacted sample of soil with a bulk unit weight of 19.62 kN/m^3 has a water content of 15 per cent. What are its dry density, degree of saturation and air content? Assume G = 2.65.
4. What are all the Atterberg limits for soil and why it is necessary?
5. Define sieve analysis and sedimentation analysis and what is the necessity of these two analyses?
6. Determine the maximum possible voids ratio for a uniformly graded sand of perfectly spherical grains
7. What is a zero air voids line? Draw a compaction curve and show the zero air voids line.
8. What is porosity of a given soil sample?
9. What is water content in given mass of soil?
10. Define: (a) Porosity (b) Void ratio.
11. Define effective size of particle in sieve analysis.
12. Write any two engineering classification system of soil
13. List any one expression for finding dry density of soils.
14. Define soil mechanics
15. Define the teams of plastic index, saturated mass density?
16. Distinguish between relative density, relative compaction
17. Distinguish between discharge velocity seepage velocities
18. Can liquid limit of any soil be more then 100%substance yours answer
19. Differentiate b/w density and unit weight of soil
20. Define liquidity index of the soil is ‘0’find its consistency index
21. What do you understand by consistency test on soil? Indicate its significance

22. What is the function of A-line Chart in soil classification?
23. Write the major soil classifications as per Indian Standard Classification System.
24. Differentiate standard proctor from modified proctor test

PART - B

1. Write down a neat procedure for determining water content and specific gravity of a given soil in the laboratory by using a pycnometer
2. Sandy soil in a borrow pit has unit weight of solids as 25.8 kN/m^3, water content equal to 11% and bulk unit weight equal to 16.4 kN/m^3. How many cubic meter of compacted fill could be constructed of 3500 m3 of sand excavated from borrow pit, if required value of porosity in the compacted fill is 30%. Also calculate the change in degree of saturation.
3. The mass of wet soil when compacted in a mould was 19.55 kN. The water content of the soil was 16%. If the volume of the mould was 0.95 m3. Determine (i) dry unit weight, (ii) Void ratio, (iii) degree of saturation and (iv) percent air voids. Take G = 2.68.
4. An earthen embankment of 106 m3 volume is to be constructed with a soil having a void ratio of 0.80 after compaction. There are three borrowing pits marked A, B and C having soils with voids ratios of 0.90, 0.50 and 1.80 respectively. The cost of excavation and transporting the soil is Rs 0.25, Rs 0.23 and Rs 0.18 per m3 respectively. Calculate the volume of soil to be excavated from each pit. Which borrow pit is the most economical? (Take G = 2.65).
5. In a hydrometer analysis, the corrected hydrometer reading in a 1000 ml uniform soil suspension at the start of sedimentation was 28. After a lapse of 30 minutes, the corrected hydrometer reading was 12 and the corresponding effective depth 10.5 cm. the specific gravity of the solids was 2.68. Assuming the viscosity and unit weight of water at the temperature of the test as 0.001 Ns/m^2 and 9.81 kN/m^3 respectively. Determine the weight of solids mixed in the suspension, the effective diameter corresponding to the 30 minutes reading and the percentage of particle finer than this size.
6. A laboratory compaction test on soil having specific gravity equal to 2.67 gave a maximum dry unit weight of 17.8 kN/m3 and a water content of 15%. Determine the degree of saturation, air content and percentage air voids at the maximum dry unit weight. What would be theoretical? Maximum dry unit weight corresponding to zero air voids at the optimum water content?
7. A soil sample has a porosity of 40 per cent. The specific gravity of solids is 2.70. Calculate i) Voids ratio ii) Dry density and iii) Unit weight if the soil is completely saturated.
8. A soil has a bulk unit weight of 20.11 KN/m3 and water content of 15 percent. Calculate the water content of the soil partially dries to a unit weight of 19.42 KN/m3 and the voids ratio remains unchanged.
9. Explain Standard Proctor Compaction tests with neat sketches
10. Soil is to be excavated from a barrow pit which has a density of 17.66kN/m3 and water content of 12%. The specific gravity of soil particle is2.7. The soil is compacted so that water content is 18% and dry density

is16.2 kN/m3. For 1000 cum of soil in fill, estimate. (i) The quantity of soil to be excavated from the pit in cum and (ii) The amount of water to be added. Also determine the void ratios of the soil in borrow pit and fill.

11. Explain all the consistency limits and indices.
12. Explain in detail the procedure for determination of grain size distribution of soil by sieve analysis
13. An earth embankment is compacted at a water content of 18% to a bulk density of 1.92 g/cm3. If the specific gravity of the sand is 2.7, find the void ratio and degree of saturation of the compacted embankment.

UNIT-II: SOIL WATER AND WATER FLOW

PART – A

1. What are the different types of soil water?
2. List out the methods of drawing flow net.
3. What is meant by total stress, neutral stress and effective stress?
4. What is meant by capillary rise in soil and how it affects the stress level in soils?
5. State and explain Darcy's law.
6. What is capillary rise?
7. What is surface tension?
8. What are the different forms of soil water?
9. Write down the uses of Flow net.
10. Define Neutral stress.
11. What is seepage velocity?
12. What is pore pressure?
13. Define relative compaction
14. Illustrate the effect of grain size on specific surface how the engineering behavior of soil.
15. What are the different types of soil water?
16. List out the method of drawing flow net
17. Prove the effective stress soil mass is independent variation in water table above the ground surface.
18. What are The Importance of Effective Stress
19. What are the uses of flow net
20. What is surface tension?
21. What is capillary rise?
22. What are the Calculation of total flow

PART - B

1. The water table in a deposit of sand 8 m thick is at a depth of 3 m below the ground surface. Above the water table, the sand is saturated with capillary water. The bulk density of sand is 19.62 kN/m3. Calculate the effective pressure at 1m, 3m and 8m below the ground surface. Hence plot the variation of total pressure, neutral pressure and effective pressure over the depth of 8m.

2. Write down the procedure for determination of permeability by constant head test in the laboratory.

3. Compute the total, effective and pore pressure at a depth of 20 m below the bottom of a lake 6 m deep. The bottom of lake consists of soft clay with a thickness of more than 20 m. the average water content of the clay is 35% and specific gravity of the soil may be assumed to be 2.65.

4. What will be the ratio of average permeability in horizontal direction to that in the vertical direction for a soil deposit consisting of three horizontal layers, if the thickness and permeability of second layer are twice of those of the first and those of the third layer twice those of second?

5. The subsoil strata at a site consist of fine sand 1.8 m thick overlying a stratum of clay 1.6 m thick. Under the clay stratum lies a deposit of coarse sand extending to a considerable depth. The water table is 1.5 m below the ground surface. Assuming the top fine sand to be saturated by capillary water, calculate the effective pressures at ground surface and at depths of 1.8 m, 3.4 m and 5.0 m below the ground surface. Assume for fine sand G = 2.65, e = 0.8 and for coarse sand G = 2.66, e = 0.5. What will be the change in effective pressure at depth 3.4 m, if no capillary water is assumed to be present in the fine sand and its bulk unit weight is assumed to be 16.68 kN/m3. The unit weight of clay may be assumed as 19.32 kN/m3

6. In a constant head permeameter test, the following observations were taken. Distance between piezometer tappings = 15 cm, difference of water levels in piezometers = 40 cm, diameter of the test sample = 5 cm, quantity of water collected = 500 ml, duration of the test = 900 sec. determine the coefficient of permeability of the soil. If the dry mass of the 15 cm long sample is 486 g and specific gravity of the solids is 2.65. Calculate seepage velocity of water during the test.

7. A foundation trench is to be excavated in a stratum of stiff clay, 10m thick, underlain by a bed of coarse sand (fig.1.). In a trial borehole the ground water was observed to rise to an elevation of 3.5m below ground surface. Determine the depth upto which an excavation can be safely carried out without the danger of the bottom becoming unstable under the artesian pressure in the sand stratum. The specific gravity of clay particles is 2.75 and the void ratio is 0.8. if excavation is to be carried out safely to a depth of 8m, how much should the water table be lowered in the vicinity of the trench?

8.The following data were recorded in a constant head permeability test. Internal diameter of permeameter = 7.5cm

Head lost over a sample length of 18cm = 24.7cm

Quantity of water collected in 60 Sec = 626 ml Porosity of soil sample was 44%

Calculate the coefficient of permeability of the soil. Also determine the discharge velocity and seepage Velocity during the test.

9. The discharge of water collected from a constant head permeameter in a period of 15 minutes is 500 ml. the internal diameter of the permeameter is 5 cm and the measured difference in head between two gauging points 15 cm vertically apart is 40 cm. calculate the coefficient of permeability. If the dry weight of the 15 cm long sample is 486 gm and the specific gravity of the solids is 2.65, calculate the seepage velocity.

10. Explain in detail the laboratory determination of permeability using constant head method and falling head method.

11. Explain in detail the procedure for drawing the phreatic line for an earthen dam.

UNIT-III: STRESS DISTRIBUTION AND SETTLEMENT

PART – A

1. Write down Boussinesque equation for finding out the vertical stress under a single concentrated load.
2. Define normally consolidated clays and over consolidated clays.
3. Explain the method of estimating vertical stress using Newark's influence chart.
4. What are the assumptions made in Terzaghi's one dimensional consolidation theory?
5. What is the use of influence chart in soil mechanics?
6. Differentiate between 'Compaction' and 'Consolidation'.
7. Write down the use of influence charts.
8. What are isochrones?
9.When a soil mass is said to be homogeneous?
10. What are isobars?
11. Differentiate Consolidation and Compaction.
12. List the components of settlement in soil
13. What are the two theories explaining the stress distribution on soil?
14. Define hydrodynamic log
15. Define hydro dynamic pressure.
16. Define primary consolidation
17. Write the equation of consolidated settlement of a normally consolidated soil?
18. Write the assumptions' of tarzahgi's theory of one dimensional consolidation
19. List out the factors affecting the time factors and hence the degree of consolidation?
20.What are the hydrodynamic equations of one-dimensional consolidation?

PART - B

1. A water tank is supported by a ring foundation having outer diameter of 10 m and inner diameter of 7.5 m. the ring foundation transmits uniform load intensity of 160 kN/m2. Compute the vertical stress induced at depth of 4 m, below the centre of ring foundation, using (i) Boussinesque analysis and (ii) Westergaard's analysis, taking $\mu = 0$

2. A stratum of clay with an average liquid limit of 45% is 6m thick. Its surface is located at a depth of 8m below the ground surface. The natural water content of the clay is 40% and the specific gravity is 2.7. Between ground surface and clay, the subsoil consists of fine sand. The water table is located at a depth of 4m below the ground surface. The average submerged unit weight of sand is 10.5 kN/m3 and unit weight of sand above the water table is 17 kN/m3. The weight of the building that will be constructed on the sand above clay increases the overburden pressure on the clay by 40 kN/m2. Estimate the settlements of the building.

3. A concentrated point load of 200 kN acts at the ground surface. Find the intensity of vertical pressure at a depth of 10 m below the ground surface and situated on the axis of the loading. What will be the vertical pressure at a point at a depth of 5 m and at a radial distance of 2 m from the axis of loading? Use Boussinesque analysis.

4. Explain with a neat sketch the Terzhaghi's one dimensional consolidation theory.

5. The load from a continuous footing of width 2m, which may be considered to be strip load of considerable length, is 200 kN/m2. Determine the maximum principal stress at 1.5m depth below the footing, if the point lies (i) directly below the centre of the footing, (ii) directly below the edge of the footing and (iii) 0.8m away from the edge of the footing.

6. What are different components of settlement? Explain in detail.

7. In a laboratory consolidometer test on a 20 mm thick sample of saturated clay taken from a site, 50% consolidation point was reached in 10 minutes. Estimate the time required for the clay layer of 5 m thickness at the site for 50% compression if there is drainage only towards the top. What is the time required for the clay layer to reach 50% consolidation if the layer has double drainage instead of single drainage.

8. What are the various components of a settlement? How are these estimated?

9. Explain the Newark's influence chart in detail.

10. How will you determine preconsolidation pressure?

11. An untrained soil sample 30cm thick got 50% consolidation in 20 minutes with drainage allowed at top and bottom in the laboratory. If the clay layer from which the sample was obtained is 3m thick in field condition, estimate the time it will take to consolidate 50% with double surface drainage and in both cases, consolidation pressure is uniform.

12. Derive Boussinesque equations to find intensity of vertical pressure and tangential stress when a concentrated load is acting on the soil.

13. Explain the assumptions made by Boussinesque in stress distribution on soils.

14. A line load of 100 kN/m run extends to a long distance. Determine the intensity of vertical stress at a point, 2 m below the surface and i) Directly under the line load and ii) At a distance 2 m perpendicular to the line. Use Boussinesq's theory

15. A layer of soft clay is 6 m thick and lies under a newly constructed building. The weight of sand overlying the clay layer produces a pressure of 2.6 kg/cm2 and the new construction increases the pressure by 1.0 kg/cm2. If the compression index is 0.5. Compute the settlement. Water content is 40% and specific gravity of grains is 2.65.

UNIT-IV: SHEAR STRENGTH

PART – A

1. Write down the Mohr's-Coulomb failure envelope equation.
2. Why triaxial shear test is considered better than direct shear test?
3. What are different types of triaxial compression tests based on drainage conditions?
4. Explain the Mohr–Coulomb failure theory.
5. State the principles of Direct shear test?
6. What is the effect of pore pressure on shear strength of soil?
7. How will you find the shear strength of cohesion less soil?
8. List out the types of shear tests based on drainage.
9. What is shear strength of soil?
10. Write down the Coulomb's expression for shear strength
11. How will you find the shear strength of cohesive soil?
12. What are the advantages of Triaxial Compression Test?
13. Define 'angle of repose' of soil.
14. Write the expression for coulomb's law.
15. What are the merits and demerits of direct shear test?
16. What are the different types of failure of a triaxcal compression test specimen?
17. What do you mean by stress-path?
18. Give the expression to find shear strength by vane shear test?
19. What are the advantages of triaxial test?
20. Type of triaxial test

PART - B

1. Obtain the relationship between the principal stresses in triaxial compression test using Mohr-Coulomb failure theory
2. Two identical soil specimens were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770 kN/m2 when the cell pressure was 2000 kN/m2. Second specimen failed at a deviator stress of 1370 kN/m2 under a cell pressure of 400 kN/m2. Determine the value of c and Φ analytically. If the same soil is tested in a direct shear apparatus with a normal stress of 600 kN/m2, estimate the shear stress at failure.
3. A saturated specimen of cohesion less sand was tested in triaxial compression and the sample failed at a deviator stress of 482 kN/m2 when the cell pressure was 100 kN/m2 under the drained conditions. Find the effective angle of shearing resistance of sand. What would be the deviator stress and the major principal stress at failure for another identical specimen of sand, if it is tested under cell pressure of 200 kN/m2. Use either Mohr's circle method or analytical method
4. Write down a step by step procedure for determination of cohesion of a given clayey soil by conducting unconfined compression test.
5. Explain with neat sketches the procedure of conducting direct shear test. Give its advantages over other methods of finding shear strength of soil
6. (i) Write a brief critical note on unconfined compression test. (ii) What are the advantages and disadvantages of triaxial compression test.
7. A vane, 10 cm long and 8 cm in diameter, was pressed into soft clay at the bottom of a bore hole. Torque was applied and gradually increased to 45 N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil. The remolded soil was sheared at a torque of 18 N-m. Calculate the cohesion of the clay in the natural and remolded states and also the value of the sensitivity
8. Describe the triaxial shear test. What are the advantages of triaxial shear test over the direct shear test?
9. Explain the Triaxial compression test to determine the shear strength of soil.
10. Explain drained behavior of clay with reference to shear strength.
11. Explain the direct shear test to determine the shear strength of soil.
12. Explain the Mohr-Coulomb failure theory
13. EThe following data were obtained in a direct shear test. Normal pressure 20 kN/m2, Tangential pressure = 16 kN/m2, Angle of internal friction = 200, Cohesion = 8 kN/m2. Represent the data by Mohr's circle and compute the principal stresses and the direction of principal planes xplain with neat sketch Direct Shear method of finding Shear Strength
14. Compare the merits and demerits of triaxial compression test
15. A particular soil failed under a major principal stress of 300 kN/m2 with a corresponding minor principal stress of 100 kN/m2. If for the same soil, the minor principal stress had been 200 kN/m2. Determine what the major principal stress would have been if (i) Φ = 300 and (ii) Φ = 00.

16. A Cylindrical specimen of dry sand was tested in a triaxial test. Failure occurred under a cell pressure of 1.2 kg/cm2 and at a deviator stress of 4.0kg/cm2. Find (i) Angle of shearing resistance of the soil. (ii) Normal and shear stresses on the failure plane. (iii) The angle made by the plane with the minor principal plane. (iv) The maximum shear stress on any plane in the specimen at the instant of failure

UNIT-V: SLOPE STABILITY

PART-A

1. Differentiate finite slope and infinite slope.

2. Write down the expression for factor of safety of an infinite slope in case of cohesion less soil.

3. List out any two slope protection methods.

4. What do you mean by Tension crack?

5. Define critical surface of failure.

6. What are different factors of safety used in the stability of slopes?

7. What is a stability number? What are the uses of stability charts?

8. State the two basic types of failure occurring in finite slopes.

9. What is a slide?

10. What are the different types of Slope failure?

11. State some of the Slope protection measures

12. Mention the types of slopes in soil.

13. Define stability number

14. What are the three forces acting in circular failure while analysis through friction circles method?

15. What do you mean by slide?

16. Why does a slope be analyzed?

17. What is the Factor of safety used in stability Analysis of slopes?

18. What is Infinite Slope Analysis?

19. List out the Method of slices

20.Define Brush Layering

PART-B

1. Explain the procedure to calculate the factor of safety of a finite slope possessing both cohesion and friction (c - Φ) by method of slices

2. A slope is to be constructed in a soil for which c = 0 and Φ = 36°. 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 below the surface? The saturated unit weight of the soil is 19 kN/m3

3. A new canal is excavated to a depth of 5 m below ground level through a soil having the following characteristics: C = 14 kN/m2; Φ = 15°; e = 0.8 and G = 2.70. The slope of banks is 1 in 1. Calculate the factor of safety with respect to cohesion when the canal runs full. If it is suddenly and completely emptied, what will be the factor of safety?

4. Write down the procedure for determining the factor of safety of a given slope by friction circle method.

5. A canal is to be excavated to a depth of 6m below ground level through a soil having the following characteristics c = 15 kN/m2, Φ = 20°, e = 0.9 and G = 2.67. The slope of the banks is 1 in 1. Determine the factor of safety with respect to cohesion when the canal runs full. What will be the factor of safety if the canal is rapidly emptied completely?

6. Explain with neat sketches the Bishop's method of stability analysis.

7. What are different types of slope failures? Discuss the various methods for improving the stability of slopes.

8. An embankment 10 m high is inclined at 35to the horizontal. A stability analysis by the method of slices gave the following forces: ΣN = 900kN, ΣT = 420kN, ΣU = 200kN. If the length of the failure arc is 23.0 m, find the factor of safety. The soil has c = 20kN /m2 and Φ = 15o.

9. Explain the Swedish slip circle method in detail

10. Explain Taylor's stability number and its applicability

11. Explain in detail the friction circle method of stability analysis for slopes with sketch

12. Explain any four methods of slope protection.

13. A cut 9 m deep is to be made in clay with a unit weight of 18 kN/m^3 and cohesion of 27 kN/m^2. A hard stratum exists at a depth of 18 m below the ground surface. Determine from Taylor's charts if a 300 slope is safe. If a factor of safety of 1.50 is desired, what is a safe angle of slope?

14. Explain in detail the various methods to protect slopes from failure. Explain the procedure to calculate the factor of safety of a finite slope possessing both cohesion and friction ($c - \varphi$) by method of slices.

15. A slope is to be constructed in a soil for which c = 0 and φ = 36°. 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 will below the surface? The saturated unit weight of the soil is 19 kN/m^3.

****