GEOTECHNICAL ENGINEERING –I

B.Tech. III Year/ II-Semester
2016-2017

Department of Civil Engineering

G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY: KURNOOL

(Approved By Aicte, New Delhi, Affiliated To J.N.T.U, Anantapur)
Nandikotkur Road, Kurnool-518002(A.P)
Web: www.gpcet.ac.in

UNIT 1

Short Answer Questions

1. State the process of formation of soil
2. What do you mean by three phase system with its use and blockdiagram.
3. Explain the significance of a grain size distribution curve.Define:a) Water content, b) porosity, c) degree of saturation, d) void ratio.
4. Define :a) Dry density, b) saturated unit weight, c) submerged unit weight.
5. Define consistency limits
6. Write the expression for toughness index, flow index and drawplasticity chart
7. What is IS classification of soil and the principle of soil classificationA sample weighing 18kn/m3 and has water content of 30%. Thespecific gravity of soil particles is 2.68. Determine void ratio andporosity.
8. Differentiate between saturated density and bulk density.

Long Answer Questions

1. Explain the process of formation of soil
2. Explain in detail the laboratory methods for grain size distribution o ffine and coarse soil.
3. Starting from three phase representation of soil mass, derive the relationship between bulk unit weight, specific gravity, void ratio and degree of saturation
4. With the help of three phase diagram, define the following:Voids ratio (ii) Porosity (iii) Degree of saturation (iv) Water content(v) Absolute/true specific gravity (vi) Apparent specific gravity (vii)Air content (viii) Percentage of air voids and (ix) Relative density.
5. Explain the principle of hydrometer method.
6. A sample of saturated soil has a water content of 25% and a bulk unit weight of 20k /m3 . Determine the (i) dry unit weight (ii) void ratio (ii) specific gravity of the soil. What would be the bulk unit weight of the soil if the soil is compacted for the same void ratio but with a degree of saturation 90%.

UNIT 2

Short Answer Questions

7. State Darcy’s law and its limitations.
8. Write the expression of permeability in stratified soils.
9. Differentiate between absorbed and capillary water in soils.
10. Explain the factors affecting the permeability of soil.
11. Define effective ,neutral, and total stress
12. What are the uses of flow nets?
13. Explain quick sand condition
14. What are the salient characteristics of a flow net

Long Answer Questions

1. Explain the factors affecting the permeability of soil.
2. Determination of coefficient of permeability in a laboratory and discuss their limitations.

3. What is darcy’slaw ?what are its limitations?
4. What are the characteristics of flow nets?
5. Discuss the properties and applications of flow nets and explain quick sand phenomenon.
6. Describe the electrical analogy of flow net construction.
7. Describe pumping-out method for the determination f the c efficient of permeability in the field?
8. Describe pumping-in method for the determination f the cefficient of permeability in the field? Differentiate between absorbed and capillary water in s ils and what are the advantages and disadvantages of coefficient of permeability.
9. What is seepage velocity, coefficient of percolation and quick sand.

UNIT 3

Short Answer Questions

1. What is pressure bulb.
2. What are the expressions for the Boussinesq's and westergaard's solution for point load.
3. State Boussinesq's equation for vertical stress at a point due to a load on the surface of an elastic medium.
4. Derive the principle of construction of Newmark's chart and explain its use.
5. A load 1000KN acts as appoint load at the surface of the s il mass.Estimate the stress at a point 2m below 3m away from the point ofaction of the load by Boussinesq's formula. Compare the value with the result from Westergaard's theory.
6. A circular area on the surface of an elastic mass of great extent carries a uniformly distributed load of 120KN/m2. The radius of the circle is 3m. compute the intensity of vertical pressure at a point 5mbeneath the centre of the circle using Boussinesq's method.
7. What is the mechanism of compaction. Discuss the effect of compaction on soil properties.
8. Write a short notes on field compaction control

Long Answer Questions

1. State the Boussinesq'sequation for vertical stress at a point due to a load on the surface of an elastic medium .
2. Derive as per Boussinesq's theory, expression for vertical stress at any point in a soil mass due to strip load .
3. Derive the Westergaard'ssolution and limitations of elastic theories.
4. Derive vertical stress under trapezoidal loads, horizontal load, inclined load.
5. Explain the Newmark's Influence charts and their uses.
6. Describe standard proctor test and the modified proctor test.
7. Write short notes on method on compaction and field compaction method.
8. Discuss the effect of compaction on soil properties.
9. What is the effect of compaction on the engineering properties of the soil. How will you decide if the soil is to be compacted towards the dry of the optimum or the wet of the optimum.
10. What are the different methods of compaction adopted in the field?
11. How would you select the type of roller to be used in the field?

UNIT 4

Short Answer Questions

1. Define normally consolidated, under consolidated and over consolidated soils.
2. Explain the significance of pre-consolidation pressure.
3. Explain Terzaghi's assumptions
4. Define compression index, coefficient of consolidation
5. Differentiate between compaction and consolidation of soils.
6. Define immediate settlement, primary consolidation, and secondary consolidation.
7. Explain logarithm of time fitting method
8. Differentiate betweenstandard and modified Proctor test
9. Discuss Terzaghi's theory of consolidation.
10. A sand fill compacted to bulk density of 18.84KN/m3 is to be placed on a compressible saturated marsh deposit 3.5m thick. The height of the sand fill is to be 3m. if the volume compressibility mv of the deposit is 7 x 10-4 m2/KN, estimate final settlement of the fill.

Long Answer Questions

1. Explain spring analogy for primary consolidation.
2. Discuss Terzaghi's theory of consolidation, stating the various assumptions and their validity
3. Expalin the different e-log p curves for the consolidation.
4. Differentiate between (i) primary consolidation and secondary consolidation (ii) standard and modified Proctor test.
5. How do you determine the pre-consolidation pressure and its determination in soil engineering practice
6. Explain the significance of pre-consolidation pressure. Describe the Casagrande method of determining it
7. Explain with spring analogy, Terzaghi's theory of one dimensional consolidation
8. Write a brief procedure of consolidation test and to determine thecoefficient of consolidation by both logarithmic time fitting method and square root of time method.
9. What is over consolidation soil? Explain briefly with an example.
10. Explain the square root of time fitting method of determining the coefficient of consolidation of a clay sample.

UNIT 5

Short Answer Questions

1. State Mohr- Coulomb failure theories.
2. Define Dilantacy, Critical void ratio ,liquefaction, Shear strength of clays.
3. Explain different types of soils.
4. What are the merits and demerit of triaxial test.
5. What are the merits and demerits of vane shear test.
6. What are the factors effecting of cohesion less soils.

7. What are the factors effecting of cohesive soils.
8. A series of direct shear test was conducted on soil each test was carried out till the same sample failed. The following results we e obtained. Determine cohesion intercept and angle of shearing resistance

Sample no	Normal stress (KN/m2)	Shear stresses (KN/m2)
1	15	18
2	30	25
3	45	32

Long Answer Questions

1. What are the important characteristics of Mohr's circle
2. What are the different test for shear strength
3. Explain Mohr-Coulomb theory of shear strength. Sketch typical
4. strength envelope for a soft clay, clean sand and a silty clay
5. Classify the shear tests based on drainage conditions. Explain how the pore pressure variation and volume change take place during these tests. Enumerate the field conditions which necessitate each of these tests.
6. What types of field tests are necessary for determining the shear strength parameters of sensitive clays?
7. What are the advantages and disadvantages of a triaxial compression test in comparison with a direct shear test
8. What are the advantages and disadvantages of direct shear test over triaxial test?
9. Explain about triaxial compression test Discuss the characteristics of cohesion less and cohesive soils.

10. Discuss modified failure envelope. What are its advantages and disadvantages over the standard failure envelope.
11. Derive the relation between the principle stress at failure using mohr-coulomb failure criterion.
12. Explain about liquefaction of soils.

PROBLEMS

UNIT – I

1. A sample of saturated soil has a water content of 25% and a bulk unit weight of 20k /m3 . Determine the (i) dry unit weight (ii) void ratio (ii) specific gravity of the soil. What would be the bulk unit weight of the soil if the soil is compacted for the same void ratio but with a degree of saturation 90%.
2. A soil has a liquid limit and plastic limit of 47% and 33% respectively. If the volumetric shrinkage at the liquid limit and plastic limit are 44% and 29%. Determine the shrinkage limit.
3. An undisturbed sample of soil has a volume 100cm3 and mass 200g.on oven drying for 24 hours, the mass is reduced to 170g. If G= 2.68.Determine the (i) void ratio (ii) water content and (iii) degree of saturation of soil.
4. A cylindrical specimen of cohesive soil 10cm dia and 20cm length is prepared in a mould. If the wet weight is 2.25 kg and water content is 15%. Determine the dry unit weight and the void ratio. If G=2.7 determine the degree of saturation of the sample.
5. A cylindrical specimen of cohesive soil 3.75cm dia and 7.5cm length weighing 175g. If the water content is 18% and G=2.68. Determine the degree of saturation. What would be the error in the degree of saturation , if it would have been an error of 1mm in measuring the length.
6. The plastic limit of soil is 25% and its plasticity index is 8%. When the soil is dried from its state at plastic limit, the volume change is 25% of its volume at plastic limit. Similarly the corresp nding volume change for the liquid limit to the dry state is 34% f its volume at liquid limit. Determine the shrinkage limit and shrinkage ratio.

UNIT – II

1. A sand sample of 35 cm2 cross sectional area and 20 cm long was tested in a constant head permeameter. Under a head of 60 cm, thedischarge was 120 ml in 6 min. The dry weight of sand used for thetest was 1 120 g, and Gs = 2.68. Determine (a) the hydraulic conductivity in cm/sec, (b) the discharge velocity, and (c) the seepage velocity
2. In a falling head permeameter, the sample used is 20 cm long havinga cross-sectional area of 24 cm2. Calculate the time required for a drop of head from 25 to 12 cm if the cross sectional area of the stand pipe is 2 cm2. The sample of soil is made of three layers. The thickness of the first layer from the top is 8 cm and has a value of k{= 2 x 10"4 cm/sec, the second layer of thickness 8 cm has k2 = 5 x 10~4 cm/sec and the bottom layer of thickness 4 cm has & k3 = 7 x 10-4 cm/sec. Assume that the flow is taking place perpendicular to the layers
3. A sand sample of 0.25 m length was subjected to a constant head permeability in a permeameter having an area of 307 x 10-4 m2. A discharge of 100 cc was obtained in a period of 60 sec nds under a head of 0.39 m. Height of dry sand in the sample was 1350 gramsand the specific gravity of sand particles was 2.67. determine (i)Coefficent of permeability (ii) Superficial velocity (iii) Seepage velocity
4. In a falling head permability test, head causing flow was initially 500 mm and it drops to 20 mm in 5 minutes. Calculate the time required for the head to fall to 250 mm.

5. The following details refers to a test to determine the permeability of the soil: Thickness of specimen =25 mm; diameter of specimen= 75mm; diameter of standing pipe=10 mm; initial head at start=1000mm; water level after 3hrs 20 minutes= 800 mm. Determine the permeability of the soil. If voids ratio of the sample is 0.75, what is the permeability of the same soil at a voids ratio of 0.9?
6. Determine the average coefficent of permeability in directions parallel and perpendicular to the planes of a stratified deposit of soil consisting of 3 layers of total thickness 3 m. the top and bottom layers are 0.5 m and 0.8 m thick. The values of K for top, middle, and bottom layers are 2×10-4 cm/s, 3×10-3 cm/s, 1×10-2 cm/s respectively.
7. A stratifies layer of soils consists of 4 layers of equal thickness the coefficient of permeability of second, third and fourth layers are respectively ½, 1/3 and twice of the permeability of the top layer. Compute the average permeabilities of the deposit, parallel and perpendicular to the direction of stratification in terms of permeability of top layer.
8. If a falling head permeameter test the initial head is 40 cm. The head drops by 5 cm in 10 minutes. Calculate the time required to run the test for the final head to be 20 cm. If the sample is 6 cm in height and 50 cm2 in cross sectional area, calculate the coefficient of permeability taking area of stand pipe = 0.5cm2 .
9. The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 12m the soil consists of very fine sand having an average void ratio of 0.65. Above the water table the sand has anaverage degree of saturation of 50%. Calculate the effective pressure

UNIT – III

1. A rectangular area of 2 m X 4m carries u.d.l. of 10t /m2 at the g ound surface. Estimate the vertical pressure at the depth of 8m vertically below a corner of the loaded area.
2. A circular area is loaded with a uniform load intensity of 100 kN/m2at groundsurface. Calculate the vertical pressure at a point P so situated on the vertical line through the centre of loaded area that thearea subtends an angle 90O at P. use the Boussinesq analysis.
3. Two column A and B are standing 5m apart. Load transferred though them may be taken as point load. Through column A and f 400 kN are acting. Calculate the resultant vertical pressure due to these load on a horizontal plane 2m below the ground surface at points vertically below the column A and B.
4. A bed of compressible clay 4 m thick has pervious sand on the top and impervious rock at the bottom. In a consolidation test on an undisturbed sample of clay from this deposit, 90% settlement was reached in 4 hours. The sample was 20 mm thick. Estimate the time in years for the building founded over this deposit to reach 90% of its settlement.

5. During a compaction test, a soil attains a maximum dry density of 18 kN/m3 at a water content of 12%. Determine the degree of saturation and percent air voids at maximum dry density. Also find the theoretical maximum dry density corresponding to zero air voids at OMC. The specific gravity of soilis 2.67. World

6. The maximum dry density of a sample by the light compaction test is1.78g/ml at an optimum water content of 15%. Find the air voids andthe degree of saturation. G =2.67 what would be the corresponding value of dry density on the zero air void line at O. .C.

7. A cylindrical specimen of a cohesive soil of 10cm diameter and 20cmlength was prepared by compaction in a mould. If the wet mass of the specimen wae 3.25Kg and its water content was 15% determine the dry density and void ratio If the specific gravity of the particles was 2.70 find the degree of saturation.

UNIT – IV

1. A soil sample 20 mm thick takes 20 minutes to reach 205 consolidation. Find the time taken for a clay layer 6 m thick to each 40% consolidation. Assuming double drainage in b th the cases.

2. The stresses on a failure plane in a drained test on a cohesion less soil are as under: Normal stress (σ) =100 kN/m2 Shear stress (τ) = 40 kN/m2 (i) Determine the angle of shearing resistance and the angle which the failure plane makes with the major principal plane. Also find the major and minor principal stresses.

3. Saturated soil of 5 m thick lies above an impervious stratum and below a pervious stratum. It has a compression index of 0.25 with k = 3.2×10-10 m/sec. Its void ratio at a stress of 147 kN/m2 is 1.9. Compute (i) The change in voids ratio due to increase of stress to 196 kN/m (ii) Coefficient of volume compressibility (iii) Coefficient of consolidation (iv) Time required for 50% consolidation.
4. A sample of soil was prepared by mixing a quantity of dry soil with 10% by mass of water. Find the mass of this wet mixer required to produce a cylindrical, compacted specimen of diameter and 12.5cm deep and having 6%air content. Find also the void ratio and the dry density of the specimen if G=2.68.
5. A long strip footing of width 2m carries a load of 400KN/m. calculate the maximum stress at a depth of 5m below the centre line of footing compare the results with 2:1 distribution method.
6. Determine the vertical stress at a point p which is 3m below and at a radial distance of 3m from the vertical load of 100KN.Use westergaard's solution.
7. Calculate the vertical stress at a point p at a depth of 2.5m directly under the centre of circular area of radius 2m and subjected to a load100KN/m2. Also calculate the vertical stress at a point Q which is at the same depth of 2.5m away from the centre of the loaded area.
8. A square foundation of (5m x 5m) is to carry a load of 4000KN.calculate the vertical stress at a depth of 5m below the centreof the foundation. IN=0.084 for m=n=0.50 also determine the vertical stress using the 1:2 distribution

UNIT – V

1. A soil specimen when tasted in unconfined compressi n test fails at axial test of 120kN/m2 the same sample tested in tri-axial compression test. The failure occurs at cell pressure f 40kN/m2 and axial deviator stress of 160kN/m2. Determine shear strength parameter.
2. A UU test is carried out on a saturated normally cons lidated clay sample at a confining pressure of 3 kg/cm 2. . The deviator stress at failure is 1 kg/cm2.
3. Two samples were tested in a triaxialmachine.The all found pressure maintained further first sample was 2kg/cm 2 and 20kg/cm2 and the failure occurred at additional axial

stress of 7.7 kg/cm2,while for the second the values were 5.0 kg/cm2 and 13.7 kg/m2 resp. Find c and ¢ of the soil.

4. A cylindrical specimen of a saturated soil fails at an axial stress of 180 kN/m2 in an unconfined compression test. The failure plane makes an angle of 54º with horizontal. Calculate the shear strength parameters of soil.
5. A vane 11.25 cm long, and 7.5 cm in diameter was pressed into soft clay at the bottom of a borehole. Torque was applied to cause failure of soil. The shear strength of clay was found to be37 kN/m2. Determine the torque that was applied.
6. A series of direct shear test was conducted on soil each test was carried out till the same sample failed. The following results were obtained. Determine cohesion intercept and angle of shearing resistance and plot the mohr circle

	Sample no (KN/m2)	Normal stress KN/m2)	Shear stresses
1	15	20	
2	30	25	
3	45	30	