09/05/17

(b) (i) An embankment 10 m high is inclined at 35° to the horizontal. A stability analysis by the method of slices gave the following forces: Total normal force = 900 kN; Total tangential force = 420 kN; Total neutral force = 200 kN. If the length of the failure arc is 23 m, find the factor of safety with respect to shear strength. The soil has $c = 20$ kN/m² and $\phi = 15°$. (8)

(ii) Explain friction circle method of slope stability analysis. (5)

PART C — (1 × 15 = 15 marks)

16. (a) An unconfined aquifer is known to be 32 m thick below the water table. A constant discharge of 2 cubic metres per minute is pumped out of the aquifer through a tube well till the water level in the tube well becomes steady. Two observation wells at distances of 15 m and 70 m from the tube well show falls of 3 m and 0.7 m respectively from their static water levels. Find the permeability of the aquifer.

Or

(b) Fig. 16 (b) shows the details of an embankment made of cohesive soil with $\phi = 0$ and $c = 30$ kN/m². The unit weight of the soil is 18.9 kN/m³. Determine the factor of safety against sliding along the trial circle shown. The weight of the sliding mass is 360 kN acting at an eccentricity of 5.0 m from the centre of rotation. Assume that no tension crack develops. The central angle is 70°.

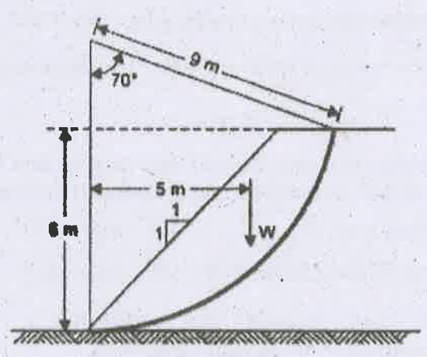

Fig. 16(b)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 71561

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the phase diagram for completely dry and fully saturated soil mass.

2. List various factors affecting compaction.

3. What is quicksand condition? Under what circumstances can it occur?

4. Write typical range of co-efficient of permeability for gravel, sand, silt and clay.

5. What is the principle behind Newmark's influence chart?

6. Define coefficient of consolidation and compression index.

7. Write the Mohr-Coulomb failure criterion for soils and explain the terms involved.

8. List the merits and demerits of triaxial test.

9. A cuffing is to be made in clay for which the cohesion is 350 kN/m² ; Bulk unit weight is 20 kN/m³. Find the maximum depth for a cutting of side slope 1.5 to 1. Factor of safety to be 1.5. Take the stability number as 0.17.

10. Mention different modes of slope failure.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A partially saturated soil from an earth fill has a natural water content of 22% and a bulk unit weight of 19 kN/m³. Assuming the specific gravity of soil solids as 2.65, compute the degree of saturation and void ratio. If subsequently the soil gets saturated, determine the dry density, buoyant unit weight and saturated unit weight. (8)

(ii) Explain Indian Standard Soil classification system for classifying cqarse grained soil. (5)

Or

(b) (i) Discuss the effect of compaction on various engineering properties of soils. (5)

(ii) A soil sample is found to have the following properties. Classify the soil according to I.S. classification system. Passing 75μ sieve = 10%; Passing 4.75 mm sieve = 70%; Uniformity coefficient = 8; Coefficient of curvature = 2.8; Plasticity Index = 4%. (8)

12. (a) (i) In a site reclamation project, 2.5 m of graded fill (γ = 22 kN/m³) were laid in compacted layers over an existing layer of silty clay (γ = 18 kN/m³) which was 3 m thick. This was underlain by a 2 m thick layer of gravel (γ = 20 kN/m³). Assuming that the water table remains at the surface of the silty clay draw the effective stress profiles for case

(1) before the fill is placed and case

(2) after the fill has been placed. (8)

(ii) Explain about various factors affecting coefficient of permeability of a soil. (5)

Or

(b) (i) In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m and 21.8×10^{-4} m² respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m. The area of cross section of stand pipe is 2.0×10^{-4} m². The sample has three layers with permeabilities 3×10^{-5} m/sec for first 0.06 m, 4×10^{-5} m/sec for second 0.06 m and 6×10^{-5} m/sec for the third 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane. (8)

(ii) Define flow net. Discuss about its uses. (5)

13. (a) (i) A concentrated load 10 kN acts on the surface of a soil mass. Using Boussinesq analysis find the vertical stress at points

(1) 3 m below the surface on the axis of loading and

(2) at radial distance of 2 m from axis of loading but at same depth of 3 m. (8)

(ii) Explain Taylor's square root time $\sqrt{t}$ method for determining coefficient of consolidation. (5)

Or

(b) (i) Write a brief critical note on "the concept of pressure bulb and its use in soil engineering practice". (5)

(ii) A 1 cm thick laboratory soil sample reaches 60% consolidation in 33 seconds under double drainage condition. Find how much time will be required for a 10 m thick layer in the field to reach the same degree of consolidation if it has drainage face on one side only? (8)

14. (a) The results of three consolidated undrained triaxial tests on identical specimens of a particular soil are as follows :

Test No.	1	2	3
Confining stress, kPa	200	300	400
Deviatoric stress at peak, kpa	244	314	384
Pore water pressure at peak, kPa	55	107	159

Determine the value of total and effective shear strength parameters. (13)

Or

(b) (i) The results of a direct shear test on a 60 mm × 60 mm specimen are given below. Determine shear strength parameters. (8)

Normal load, N	300	400	500	600
Shear force at failure, N	195	263	324	399

(ii) Sketch and discuss the stress-strain and volume change relationship for dense and loose sand. (5)

15. (a) (i) A slope of very large extent of soil with properties c' = 0 and ϕ' = 32° is likely to be subjected to seepage parallel to the slope with water level at the surface. Determine the maximum angle of slope for a factor of safety of 1.5 treating it as an infinite slope. For this angle of slope what will be the factor of safety if the water level were to come down well below the surface? The saturated unit weight of soil is 20 kN/m³. (8)

(ii) Discuss about various slope protection measures. (5)

Or

PART – C (1×15=15 Marks)

16. a) Subsurface exploration at the site of a proposed building reveals the existance of 2.4 m thick layer of soft clay below a stratum of coarse sand which is 4m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5m below the ground surface. Laboratory tests indicate the natural water content of the clay as 40%, average liquid limit as 45% and specific gravity of solids as 2.75. The unit weight of the sand above and below water table is 17.8 kN/m^3 and 21 kN/m^3 respectively. Estimate the probable settlement of the building, if its construction will increase average vertical pressure on the clay layer by 71 kPa.

OR

b) An embankment consists of clay fill for which $c' = 25$ kN/m^2 and $\phi' = 27°$ (from consolidated undrained tests with pore-pressure measurement). The average bulk unit weight of the fill is 20 kN/m^3. Estimate the shear-strength of the material on a horizontal plane at a point 20 m below the surface of the embankment, if the pore pressure at this point is 180 kN/m^2 as shown by a piezometer.

Reg. No. :

Question Paper Code : 40788

12/05/18 (FN)

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth Semester
Civil Engineering
CE 6405 : SOIL MECHANICS
(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. If the maximum, minimum and natural dry unit weight of sand are 18 kN/m^3 15kN/m^3 and 16.5 kN/m^3, find its relative density.
2. List various field compaction methods along with their suitability.
3. What is quick sand condition ? List the conditions for the occurrence of quick sand condition.
4. Derive the expression for capillary rise in a tube inserted in water.
5. Define overconsolidated, Normally consolidated and under consolidated soils.
6. List the assumptions made in Boussinesq's Analysis of stress distribution.
7. Draw the strength envelopes for fully saturated clay subjected to CD test and fully saturated sand subjected to UU test.
8. Draw typical stress-strain curve for specimens failed by brittle failure and plastic failure.
9. Differentiate the modes of failure of finite and infinite slopes.
10. What is the effect of depth of failure surface on the stability of infinite slope in cohesionless soil ?

PART – B (5×13=65 Marks)

11. a) i) A partially saturated sample of soil has a volume of 60 cc and mass of 92g. The sample is dried in an oven and its dried mass is 73.8g. If the specific gravity of solids be 2.62, find the degree of saturation, water content, void ratio, porosity, bulk unit weight and dry unit weight. (6)

ii) Explain IS soil classification system for classifying coarse grained soil. (7)

(OR)

b) i) Discuss various factors influencing compaction behaviour of soils. (5)

ii) Sandy soil in a borrow pit has unit weight of solids as 26.3 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 m^3 of sand excavated from the borrow pit, ifthe required value of porosity in the compacted fill is 30%. (8)

12. a) i) The water table in a certain area is at a depth of 4m below the ground surface.To a depth of 15m, the soil consists of very fine sand having an average void ratio of 0.7. Above the water table, the sand has an average degree of saturation of 50%. Calculate the effective stress on a horizontal plane at a depth of 10m below the ground surface. Take specific gravity of solids as 2.65. (7)

ii) List various laboratory tests for determination of coefficient of permeability and explain any one method in detail. (6)

(OR)

b) i) A stratum of sandy soil overlies a horizontal bed of impermeable material, the surface of which is also horizontal. In order to determine the in-situ permeability of the soil, a test well was made upto the bottom of the stratum. Two observation boreholes were made at distances of 12 m and 24 m respectively from the test well. Water was pumped out from the well at a rate of 180 litres/minute until the water levels became steady. The height of water in the two boreholes was found to be 4.2 m and 6.3 m respectively above the impermeable bed. Find the coefficient of permeability of the sandy soil. (7)

ii) What is flow net ? Explain in detail various uses of flow net. (6)

13. a) Two footings 6m apart (c/c distance) at the same level carry concentrated loads of 1000 kN and 1500kN respectively. Compute the vertical pressure at the following points :

1) Midway between the footings at a depth of 3m below the footing level.
2) Vertically below the centre of each footing at the same depth of 3m. (13)

(OR)

b) i) A circular area on the surface of an elastic mass of great extent carries a uniformly distributed load of 120 kN/m^2. The radius of the circle is 3m. Compute the intensity of vertical pressure at a point 5 metres beneath the centre of the circle using Boussinesq's method. (7)

ii) Explain with neat sketch Taylor's $\sqrt{t}$ method for the determination of coefficient of consolidation. (6)

14. a) Two identical specimens of a soil were tested in a triaxial apparatus. The first specimen failed at a deviator stress of 770 kPa when the cell pressure was 200 kPa, while the second specimen failed at a deviator stress on 1370 kPa under a cell pressure of 400 kPa. Determine the shear strength parameters. Also, find the deviator stress at failure when the cell pressure was 600 kPa. If the same soil is tested in a direct shear apparatus, estimate the shear stress at which the sample will fail under a normal stress of 600 kPa. (13)

(OR)

b) Samples of compacted, clean, dry sand were tested in a shear box, 6cm× 6cm, and the following observations were recorded :

Normal load (N)	100	200	300
Peak shear load (N)	90	180	270
Ultimate shear load (N)	75	150	225

Determine the angle of shearing resistance in
a) the dense state and in
b) the loose state. (13)

15. a) A new canal is excavated to a depth of 5m with banks having 1 : 1 slope. The properties of the soil are : cohesion = 14 kPa, angle of internal friction = 20°, void ratio = 0.65 and specific gravity of solids = 2.70. Calculate the factor of safety with respect to cohesion when the canal is running full. What will be the factor of safety if the slope is changed to be 30° to vertical ? The Taylor's stability number is given in the table for different slope angles for angle of internal friction = 20°.

Slope angle	30°	45°	60°	75°	90°
Stability number	0.025	0.062	0.097	0.134	0.182

(13)

(OR)

b) i) An infinite slope made of soil with c' = 20 kPa, ϕ= 20°, e = 0.65 and G = 2.7 is 10m high. The slope angle is 25°. Find the factor of safety with respect to height for the following conditions (1) when the soil is dry (2) when the slope is submerged. (6)

ii) Discuss the stability analysis of slopes by method of slices for c - ϕ soil. (7)

15. (a) (i) A 45° slope has been excavated to a depth of 8 m in a saturated clay which has following properties; $C_u = 60\ kN/m^2$, $\phi_u = 0$; and unit weight = $20\ kN/m^3$. Determine the factor of safety for the trial failure surface whose radius is 12 m and arc length is 18.84 m. The area of the trial wedge is 70 m² and centre of gravity of the trial wedge is 4.5 m away from the centre of the failure surface. (6)

(ii) Discuss various methods for improving the stability of slopes. (7)

Or

(b) (i) An infinite slope made of soil with c' = 20 kPa, $\phi' = 20°$, $e = 0.65$ and G = 2.7, is 10 m high. The slope angle is 25°. Find the factor of safety with respect to height for the following conditions :

(1) When the soil is dry

(2) When the slope is submerged. (6)

(ii) Discuss the stability analysis of slopes by Fellenius method. (7)

PART C — (1 × 15 = 15 marks)

16. (a) An unconfined aquifer is known to be 32 m thick below the water table. A constant discharge of 2 cubic metres per minute is pumped out of the aquifer through a tube well till the water level in the tube well becomes steady. Two observation wells at distances of 15 m and 70 m from the tube well show falls of 3 m and 0.7 m respectively from their static water levels. Find the permeability of the aquifer.

Or

(b) Fig. 16 (b) shows the details of an embankment made of cohesive soil with $\phi = 0$ and $c = 30\ kN/m^2$. The unit weight of the soil is 18.9 kN/m^3. Determine the factor of safety against sliding along the trial circle shown. The weight of the sliding mass is 360 kN acting at an eccentricity of 5.0 m from the centre of rotation. Assume that no tension crack develops. The central angle is 70°.

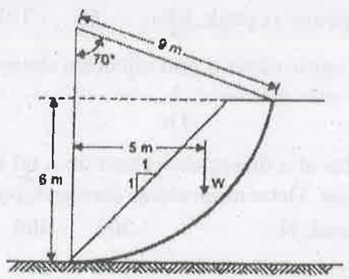

Fig.16(b)

08/05/19 FN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 52762

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulation 2013)

(Common to PTCE 6405 – Soil Mechanics for B.E. (Part-Time) Third Semester – Civil Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the phase diagram for completely dry and fully saturated soil mass.

2. List various factors affecting compaction.

3. Differentiate discharge velocity and seepage velocity.

4. State the Darcy's law of Permeability of soil.

5. Boussinesq's vertical stress due to a point load at a point which is at a depth of 'z' and at a radial distance of 'r' from the line of action of the load is 'σ_z', when the modulus of elasticity of the medium is 'E'. Find the vertical stress at the same point when the modulus of elasticity of the medium is doubled.

6. A consolidating stratum takes two years for 50 % consolidation. Find the time taken by the stratum for 90% consolidation for the same drainage condition.

7. Draw the strength envelope for fully saturated clay subjected to CD test.

8. Draw typical stress-strain curve for specimens failed by brittle failure and plastic failure.

9. State the influence of tension crack in factor of safety if the cracks are filled with water and without water.

10. How Taylor's stability Number is utilised for slope stability analysis?

PART B — (5 × 13 = 65 marks)

11. (a) (i) The liquid limit, plastic limit and shrinkage limit of a soil are 60%, 40% and 30% respectively A specimen of the soil has a volume of 100 cm³ at liquid limit. Find its volume at shrinkage limit, if the specific gravity of solids is 2.0. When oven-dried sample of the soil is subjected to liquid limit test, the liquid limit reduced to 42%. Classify the soil as per IS, if the fraction of the soil passing 75 micron sieve is 70%. (10)

(ii) Discuss the influence of size of the particles of soil on optimum moisture content. (3)

Or

(b) (i) A loose, uncompacted sand fill 1.5 m deep has a relative density of 30%. Laboratory tests on the same sand indicate that the minimum and maximum void ratios are 0.45 and 0.82 respectively. The specific gravity of solids is 2.65. If the sand fill is compacted to a relative density of 70%, what is the decrease in its thickness? Also, find the dry unit weight of the compacted sand. (7)

(ii) The maximum dry density achieved in a laboratory compaction test on a soil which is being used for building a compacted fill is 1.98 g/cc. Two field density tests have been performed in the recently completed fill, but one of these tests has produced results that are definitely incorrect. Test A indicates a relative compaction of 97% at placement water content of 14.3% whereas Test B indicates a relative compaction of 98% at a placement water content of 14.7%. Which test results are definitely incorrect? Justify your answer. Take specific gravity of solids as 2.7. (6)

12. (a) (i) Name the various methods of laboratory determination of permeability with the soil type in which they are best suited and explain any one method in details. (7)

(ii) A field pumping test has been carried out in a well which was sunk through a horizontal stratum of sand 15 m thick and underlain by a clay stratum. Two observation wells were sunk at horizontal distances of 18 m and 35 m respectively from the pumping well. The initial position of the water table was 2.5 m below the ground level. At a steady state pumping rate of 925 litres/mm. the drawdown curves in the observation wells were found to be 2.5 m and 1.50 m respectively. Estimate the coefficient of permeability of the sand. (6)

Or

(b) (i) A drainage pipe beneath a dam has become clogged with sand; coefficient of permeability of the sand is 7.5 m/day. The average difference in head water and tail water elevation is 21 m and it has been observed that there is a flow of 160 litres per day through the pipe. The pipe is 97 m long and has a cross-sectional area of 0.02 m². Find out up to what length of the pipe is filled with sand? (6)

(ii) A flow net analysis was performed for estimating the seepage loss through the foundation of a cofferdam. Results of the flow net analysis gave a number of flow line 'N_f' = 6 and number of drops 'N_d' = 16. The head of water lost during seepage was 5 m. Assume the coefficient of permeability of the soil is 'k' = 4×10^{-5} m/min. Estimate the seepage loss per meter length of the cofferdam per day. Also estimate the exit gradient if the average length of the last flow field is 0.9 m. (7)

13. (a) (i) Describe the Newmarks chart and its application. (6)

(ii) A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 3 m, 6 m, 9 m, 12 m and 15 m directly below the point load; draw the vertical stress distribution diagram along vertical axis. (7)

Or

(b) (i) Describe Terzaghi's Theory of One Dimensional Consolidation along with the Spring Analogy. (7)

(ii) A clay layer of 8 m thick with Single Drainage settles by 120 mm in 2 years. The coefficient of consolidation for this clay was found to be $6 \times 10^{-3} cm^2/s$. Calculate the likely ultimate consolidation settlement and find out how long will it take to undergo 90% of this ultimate settlement. (6)

14. (a) The results of three consolidated undrained triaxial tests on identical specimens of a particular soil are as follows :

Test No.	1	2	3
Confining stress, kPa	200	300	400
Deviatoric stress at peak, kpa	244	314	384
Pore water pressure at peak, kPa	55	107	159

Determine the value of total and effective shear strength parameters. (13)

Or

(b) (i) The results of a direct shear test on a 60 mm × 60 mm specimen are given below. Determine shear strength parameters. (7)

Normal load, N	300	400	500	600
Shear force at failure, N	195	263	324	399

(ii) Sketch and discuss the stress-strain and volume change relationship for dense and loose sand. (6)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80202

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the phase diagram for Dry Soil and Saturated Soil.

2. List any four equipment / methods for Field Compaction of Soil.

3. Differentiate discharge velocity and seepage velocity.

4. State the Darcy's law of Permeability of soil.

5. State the Boussinesq formula for Vertical Stress Distribution in Soil under a Point Load.

6. State Drainage Path lengths for Single and Double Drainage conditions for a soil layer(Height H).

7. Draw the Mohr's Circle diagram for UCC test and mention the salient features.

8. Define Liquefaction and the effects on Structural Stability due to liquefaction

9. Compare Finite Slopes and Infinite Slopes.

10. Draw a Slip Circle for a failure plane in a slope and show the forces involved.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the relationship between Porosity (n) and Void Ratio (e). (8)

(ii) A partially saturated sample from a borrow pit has a natural moisture content of 15% and bulk unit weight of 1.9 g / cc. The specific gravity of solids is 2.70. Determine the degree of Saturation and void ratio. What will be the unit weight of the soil if it gets saturated? (8)

Or

(b) (i) Describe the proctor Compaction Test in detail. (8)

(ii) Draw the diagram for the three Atterberg Limits of a soil and mark the various soil phases. (4)

(iii) Define Sensitivity and Thixotropy for a soil. (4)

12. (a) (i) A clay layer 3 m thick is having water content 45%, and specific gravity of solids 2.7. This clay layer is lying below another layer which is 5m thick Sand layer The sand layer lying at the top is having void ratio 0.6 and with Degree of saturation 40% and Gs = 2.65. The water table is at a depth of 3m below. Determine the Total Stress, Pore Pressure and Effective Stress at various levels and draw the corresponding diagrams. (12)

(ii) Define Quicksand condition and Critical Hydraulic Gradient. (4)

Or

(b) (i) List the various types of Soil water. (4)

(ii) Describe the Unconfined Pumping Out Flow and determine the coefficient of permeability of soil. Also explain Draw Down Curve. (12)

13. (a) (i) Describe the Newmark's chart and its application. (8)

(ii) A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 3m, 6m, 9m, 12m and 15m directly below the point load; draw the vertical stress distribution diagram along vertical axis. (8)

Or

(b) (i) Describe Terzaghi's Theory of One Dimensional Consolidation along with the Spring Analogy. (8)

(ii) A clay layer of 8m thick with Single Drainage settles by 120mm in 2 years. The coefficient of consolidation for this clay was found was found to be $6 * 10^{-3} cm^2 / s$. Calculate the likely ultimate consolidation settlement and find out how long it will take to undergo 90% of this ultimate settlement. (8)

14. (a) (i) Describe the Vane Shear Test in detail and explain the two methods adopted in this test – Fully submerged Vane and Partially Submerged Vane. (8)

(ii) An unconfined Compression Test was conducted on an undisturbed clay sample. The sample had a diameter of 37.5mm and length 80mm. Load at failure measured by proving ring was 28 N and the axial deformation at failure point was 13mm. Determine the unconfined compressive strength and the undrained shear strength of the clay. Plot all the results on a Mohr's Circle. (8)

Or

(b) (i) Direct Shear Test was conducted on Compacted Sand Shear Box Dimensions 60 mm * 60 mm . The readings are listed below.

Normal Load	Shear Load (N)	
(N).	Peak	Ultimate
110	95	65
225	195	135
340	294	200

Determine the Angle of Shearing resistance

(1) in the dense compacted state

(2) in the loose state. (12)

(ii) Define Deviator stress and its significance in Triaxial Shear Strength Test. (4)

15. (a) Describe the Fellinius Circle Method of analyzing the stability of slopes. (16)

Or

(b) (i). Brief total stress method of analysis of stability of slopes. (8)

(ii) Describe any four techniques for slope Protection with clear sketches. (8)

13.11.17 – AN

Reg. No. :

Question Paper Code : 50270

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Fourth Semester
Civil Engineering
CE 6405 – SOIL MECHANICS
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

PART – A **(10×2=20 Marks)**

1. Define Liquid limit.
2. List out various factors influencing compaction.
3. Define flow net. Draw a neat sketch.
4. Write the various types of field permeability test.
5. What is the use of consolidation test data ?
6. Find the compression index of remoulded soil sample with liquid limit of 40%.
7. What do you meant by Thixotropy ?
8. Write the advantages of direct shear test.
9. Define finite slope.
10. Write the formula for finding factor of safety with respect to cohesion and friction.

PART – B **(5×13=65 Marks)**

11. a) i) A soil mass in its natural state is partially saturated having a water content of 17.5 percent and void ratio of 0.87. Determine the degree of saturation,total unit weight dry unit weight what is the weight of water required to make a mass of $10m^3$ volume to get saturated assume G = 2.69. **(10)**

ii) Write the formula for flow index and plasticity index. **(3)**

(OR)

b) 500 gms of dry soil was used for sieve analysis the masses of soil retained on each sieve is given below :

I.S sieve	Mass in gms
2.00 mm	10
1.40 mm	18
1.00 mm	60
500 μ	135
250 μ	145
125 μ	56
75 μ	45

Plot the grain size distribution curve and compute the following :

a) Percentage of gravel, coarse sand, medium sand, fine sand and silt as per I.S 1498.

b) Uniformity coefficient

c) Coefficient of curvature, classify the soil. **(13)**

12. a) A sand stratum 10m thick. The water table is 2m below ground level. The unit weight of sand layers above and below water table are 17 kN/m^3 and 21 kN/m^3 respectively. The capillary rise above water table is 1 m. Draw the effective stress pore pressure and total stress diagram for the sand stratum. **(13)**

(OR)

b) Briefly explain about the Laboratory methods of permeability test with neat sketch. **(13)**

13. a) Derive the equation for Terzaghi's theory of one dimensional consolidation with a neat sketch. **(13)**

(OR)

b) Discuss in detail about the Boussineq's analysis to find vertical stress and horizontal shear stress for point load. **(13)**

14. a) Briefly discuss about the various types of triaxial shear test based in drainage condition. **(13)**

(OR)

b) The following table gives data obtained from triaxial compression test conducted under undrained condition on two specimens of same soil sample. The diameter and height are 40mm and 80mm respectively for both samples.

Specimen no	1	2
Cell pressure (KN/m^3)	100	200
Deviator load at failure (N)	637	881
Increase in volume at failure (ml)	1.1	1.5
Axial compression (mm)	5	7

Find Cu and ϕu by graphical method. **(13)**

15. a) Explain the stability analysis of finite slope by friction circle method with suitable sketch. **(13)**

(OR)

b) A canal with a depth of 5m has banks with slope 1 : 1 the properties of soil are C = 20 kN/M^2, Ø = 15°, e = 0.7, G = 2.6. Calculate the factor of safety with respect to cohesion i) when cancel runs full and ii) it is suddenly and completely emptied. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A 5 m thick saturated soil stratum has a compression index of 0.25 and coefficient of permeability 3.2×10^{-3} mm/sec. If the void ratio is 1.9m at vertical stress of 0.15 N/mm^2. Compute the void ratio when the vertical stress is increases to 0.2N/mm^2 also calculate settlement due to above stress increase and time required for 50% consolidation and 90% consolidation. **(15)**

(OR)

b) In vane shear test conducted in a soft clay deposit failure occurred at torque of 42 Nm afterwards. The vane was allowed to rotate rapidly and test was repeated in the remoulded soil. The torque at failure in the remoulded soil was 17 Nm. Calculate the sensitivity of soil. In both cases the vane was pushed completely inside soil. The height of vane and diameter across blades are 100 mm an 80 mm respectively. What will be the change in the above results if top of the vane is not in contact with soil ? **(15)**

23/11/18 (AN)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20263

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations 2013)

(Also common to : PTCE 6405 – Soil Mechanics for B.E. (Part-Time) – Third Semester – Civil Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The results of sieve analysis on three soil samples are given below. Say which soil is gap graded and justify your answer.

Sieve size, mm	Percentage passing		
	Soil A	Soil B	Soil C
4.75	100	99	98
2.0	59	62	55
0.425	28	32	55
0.075	1	0	2

2. Specify the mass of rammer, height of fall, number of layers and number of blows per layer used in the light compaction test

3. What is the influence of temperature on the coefficient of permeability of soils?

4. Flow net is drawn for a weir. The total loss of head is 5 m, the number of potential drops is 10 and the length of the flow line for the last square is 1 m. Calculate the exit gradient.

5. Boussinesq's vertical stress due to a point load at a point which is at a depth of 'z' and at a radial distance of 'r' from the line of action of the load is 'σ_z', when the modulus of elasticity of the medium is 'E'. Find the vertical stress at the same point when the modulus of elasticity of the medium is doubled.

6. A consolidating stratum takes two years for 50 % consolidation. Find the time taken by the stratum for 90 % consolidation for the same drainage condition.

7. A purely cohesive soil sample of cohesion 40 kPa is subjected to a cell pressure of 100 kPa in a triaxial compression test. Will the sample fail by shear? Justify your answer.

8. The diameter of all the Mohr circles drawn at incipient failure condition for the results of a triaxial test performed on a soil is the same and equal to 150 kPa to a scale. Find the shear strength parameters of the soil.

9. Find the factor of safety of an infinite slope having a slope angle of 28°. The slope consists of cohesionless soil with angle of internal friction of 31°.

10. In the case of $c - \phi$ soil, the slope failure of an infinite slope never takes place, if the angle of slope is equal to angle of internal friction of the soil. Why?

PART B — (5 × 13 = 65 marks)

11. (a) (i) The liquid limit, plastic limit and shrinkage limit of a soil are 60%, 40% and 30% respectively. A specimen of the soil has a volume of 100 cm^3 at liquid limit. Find its volume at shrinkage limit, if the specific gravity of solids is 2.0. When oven-dried sample of the soil is subjected to liquid limit test, the liquid limit reduced to 42%. Classify the soil as per IS, if the fraction of the soil passing 75 micron sieve is 70%. (10)

(ii) Discuss the influence of size of the particles of soil on optimum moisture content. (3)

Or

(b) (i) A loose, uncompacted sand fill 1.5 m deep has a relative density of 30%. Laboratory tests on the same sand indicate that the minimum and maximum void ratios are 0.45 and 0.82 respectively. The specific gravity of solids is 2.65. If the sand fill is compacted to a relative density of 70%, what is the decrease in its thickness? Also, find the dry unit weight of the compacted sand. (7)

(ii) The maximum dry density achieved in a laboratory compaction test on a soil which is being used for building a compacted fill is 1.98 g/cc. Two field density tests have been performed in the recently completed fill, but one of these tests has produced results that are definitely incorrect. Test A indicates a relative compaction of 97% at placement water content of 14.3% whereas Test B indicates a relative compaction of 98% at a placement water content of 14.7%. Which test results are definitely incorrect? Justify your answer. Take specific gravity of solids as 2.7. (6)

12. (a) The ground water table in a deep deposit of sand is located at 4 m from the ground level. Due to capillary action, sand is saturated for a height of 1 m from the water table. The degree of saturation of the sand above the capillary fringe is 40%. If the specific gravity of solids and average void ratio of the sand are 2.68 and 0.72 respectively, obtain the effective stress at 2 m, 3 m, 4 m and 10 m from the ground level.

Or

(b) (i) A permeameter of cross sectional area 100 cm^2, has a soil sample of length 20 cm. The sample is heterogeneous having coefficient of permeability of 1×10^{-4} cm/s for the first 7 cm and 1×10^{-3} cm/s the last 7 cm thickness. When falling head permeability test is conducted with a stand pipe of cross sectional area 2 cm^2, the head drops from 40 cm to 20 cm in 18 minutes, Find the coefficient of permeability of the middle part of the sample. (7)

(ii) A 5-m deep vertical cut is made in a stiff saturated clay of thickness 7 m that is underlain by sand. The ground water table is at a depth of 2 m from the ground level. What should be the minimum height of water in the cut so that the stability of bottom of the cut is not lost? Take specific gravity of solids and water content of the clay as 2.65 and 30% respectively. (6)

13. (a) (i) A Newmark's chart is drawn with an interval of 0.1 for σ_z / q. If there are 20 radial lines, find the influence factor. (σ_z and q are additional vertical pressure and applied loading intensity respectively). (3)

(ii) A certain clay layer has a thickness of 2 m. After one year when the clay layer was 50% consolidated a settlement of 20 mm occurred. For a similar clay layer, under similar loading and drainage conditions, how much settlement would occur at the end of one year and four years respectively, if the thickness of the new layer were 4 m? (10)

Or

(b) (i) A point in a clayey layer is subjected to a stress of 80 kPa at present. The consolidation test results conducted on a sample of the clay show a preconsolidation pressure of 120 kPa. Say whether the clay is normally consolidated or overconsolidated. Justify your answer. (3)

(ii) In a normally consolidated clay, the void ratio decreases from 1.02 to 0.92 when the effective pressure is increased from 80 kpa to 160 kPa. The coefficient of permeability of the clay for this pressure range is 1×10^{-10} m/s. How long will it take for a 2-m thick clay layer which is sandwiched between coarse sand and rock in the field to reach 60% consolidation? What is the settlement at that time? (10)

14. (a) (i) In direct shear test, find the angle made by failure plane and major principal plane respectively with respect to horizontal, if the angle of internal friction is 30°. (3)

(ii) Describe the state of soil samples A to D when the Mohr circles describing their state of stresses are as follows : for A, the Mohr circle is a dot on the normal stress axis, for B, the Mohr circle is too small to touch the strength envelope, for C, the Mohr circle is tangential to strength envelope and for D, the Mohr circle is so large that part of the circle is above the strength envelope. Also for the sample C, find the angle made by the failure plane with respect to minor principal plane. (10)

Or

(b) Following are the results of a triaxial test conducted on two specimens of the same soil. Find the shear strength parameters of the soil. If another specimen of the same soil is subjected to a cell pressure of 400 kPa, find the deviator stress at which it is likely to fail. Also for this specimen, find the normal stress and shear stress on the failure plane and locate the plane of maximum shear stress with respect to major principal plane and find the magnitude of maximum shear stress.

Cell pressure, kPa	100	200
Deviator stress at failure, kPa	300	585

15. (a) An infinite slope with a slope angle of 28° is 4.5 m high. The soil has cohesion of 30 kpa, angle of internal friction of 20° and unit weight of 19 kN/m³. Find the factor of safety with respect to cohesion. Derive the equation used if any.

Or

(b) (i) Explain with sketches, the different ways by which a finite slope may fail. State the situations where each failure is likely to happen. (6)

(ii) A purely cohesive soil has a unit weight of 18 kN/m³ and an average cohesion of 22 kPa. A hard stratum exists only at infinite depth below the ground level. A 4-m deep cutting is to be made. Find the factor of safety if the slope angle is (1) 90° (2) 53°. (7)

PART C — (1 × 15 = 15 marks)

16. (a) The unit weight of a soil at 50% and 80% saturation is 17.60 kN/m³ and 18.81 kN/m³ respectively. Find

(i) Specific gravity of solids

(ii) Void ratio

(iii) Porosity

(iv) Dry unit weight

(v) Saturated unit weight

(vi) Submerged unit weight

(vii) Water content corresponding to 100% saturation When a disturbed sample of the same soil was subjected to classification tests, the following results were obtained :

Percentage finer than 4.75 mm	: 80
Percentage finer than 0.075 mm	: 9
Liquid limit	: 23%
Plastic limit	: 15%
Size corresponding to 10% finer	: 0.09 mm
Size corresponding to 30% finer	: 1.2 mm
Size corresponding to 60% finer	: 3.4 mm

Classify the soil as per IS 1498.

Or

(b) A soil profile consists of 4-m thick sand underlain by 3-m thick clay. The clay layer overlies hard rock. A square foundation of size 2 m carrying a load of 800 kN is founded at a depth of 1.5 m from the ground level. The ground water table is at the base of the foundation. The specific gravity of solids and void ratio of the sand are 2.7 and 0.7 respectively. The degree of saturation above the water table can be assumed as 30%. The liquid limit, water content and specific gravity of solids of the clay are 40%, 27% and 2.66 respectively. Estimate the probable consolidation settlement of the clay layer, assuming the clay to be normally consolidated. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units).

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PART – C **(1×15=15 Marks)**

16. a) The unit weight of a soil at 50% and 80% saturation is 17.60 kN/m^3 and 18.81 kN/m^3 respectively. Find

i) Specific gravity of solids

ii) Void ratio

iii) Porosity

iv) Dry unit weight

v) Saturated unit weight

vi) Submerged unit weight

vii) Water content corresponding to 100% saturation. When a disturbed sample of the same soil was subjected to classification tests, the following results were obtained :

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Size corresponding to 60% finer	: 3.4 mm

Classify the soil as per IS 1498.

(OR)

b) A soil profile consists of 4-m thick sand underlain by 3-m thick clay. The clay layer overlies hard rock. A square foundation of size 2 m carrying a load of 800 kN is founded at a depth of 1.5m from the ground level. The ground water table is at the base of the foundation. The specific gravity of solids and void ratio of the sand are 2.7 and 0.7 respectively. The degree of saturation above the water table can be assumed as 30%. The liquid limit, water content and specific gravity of solids of the clay are 40%, 27% and 2.66 respectively. Estimate the probable consolidation settlement of the clay layer, assuming the clay to be normally consolidated. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units).

25/11/19/AN

Reg. No. :

Question Paper Code : 91297

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fourth Semester

Civil Engineering

CE 6405 – SOIL MECHANICS

(Regulations 2013)

(Common to PTCE 6405 – Soil Mechanics for B.E. (Part-Time) for Third Semester – Civil Engineering Regulations – 2014)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. What do you understand by CL, CI and CH clays ?

2. Show the effect of compactive energy on γd_{max} and OMC.

3. How do you know that the flow through a soil obeys Darcy's law ?

4. What is capillary stress ? How does it vary for sand and clay ?

5. State the Boussinesq formula for Vertical Stress Distribution in soil under a point load.

6. What is the effect of single and double drainage on the rate of consolidation ?

7. A purely cohesive soil sample of cohesion 40 kPa is subjected to a cell pressure of 100 kPa in a triaxial compression test. Will the sample fail by shear ? Justify your answer.

8. The diameter of all the Mohr circles drawn at incipient failure condition for the results of a triaxial test performed on a soil is the same and equal to 150 kPa to a scale. Find the shear strength parameters of the soil.

9. A cutting is to be made in clay for which the cohesion is 350 kN/m^2 ; bulk unit weight is 20 kN/m^3. Find the maximum depth for a cutting of side slope 1.5 : 1. Factor of safety to be 1.5. Take the stability number as 0.17.

10. Mention different modes of slope failure.

PART – B (5×13=65 Marks)

11. a) i) A soil sample has a diameter of 38.1 mm and a length of 76.2 mm. Its wet weight is 1.843 N and its dry weight is 1.647 N. If specific gravity of the solids is 2.7, find dry unit weight, bulk unit weight, void ratio, water content and degree of saturation. (7)

ii) Explain IS soil classification system for classifying coarse grained soil. (6)

(OR)

b) i) Discuss various factors influencing compaction behaviour of soils. (7)

ii) The sieve analysis of a soil gave the following results : % passing 75 μ sieve = 8 ; % retained on 4.75 mm sieve = 35. Coefficient of curvature = 2.5; uniformity coefficient = 7. The fine fraction gave the following results : Plasticity index = 3% ; Liquid limit = 15%. Classify the soil as per IS soil classification system. (6)

12. a) i) A clay layer 3 m thick is having water content 45% and specific gravity of solids 2.7. This clay layer is lying below another layer which is 5 m thick sand layer. The sand layer lying at the top is having void ratio 0.6 and with degree of saturation 40% and Gs = 2.65. The water table is at a depth of 3 m below. Determine the Total Stress, Pore Pressure and Effective Stress at various levels and draw the corresponding diagrams. (7)

ii) Define Quicksand Condition and Critical Hydraulic Gradient. (6)

(OR)

b) i) What are the different types of water exist in soil ? State their importance. (6)

ii) Describe the laboratory procedure involved in the determination of coefficient of permeability of fine grained soil. (7)

13. a) i) A water tank has supported by a circular foundation of diameter 10.5 m is resting on a soil stratum. The total weight of the tank including the foundation is 17,700 kN. Estimate the stress due to the above load at 0.5 m and 2.5 m depth at the center of the water tank.

ii) Explain in details the determination of coefficient of consolidation using log t method.

(OR)

b) i) For a single concentrated load 1,000 kN acting on the ground surface construct an isobar for $\sigma_z = 40 kN/m^2$. (6)

ii) A 8m thick clay layer with single drainage settles by 120 mm in 2 years. The co-efficient of consolidation of this clay was found to be 6×10^{-3} cm^2/sec. Calculate the likely ultimate consolidation settlement and find how long it will take to undergo 90% of this settlement. (7)

14. a) i) In direct shear test, find the angle made by failure plane and major principal plane respectively with respect to horizontal, if the angle of internal friction is 30°. (3)

ii) Describe the state of soil samples A to D when the Mohr circles describing their state of stresses are as follows : for A, the Mohr circle is a dot on the normal stress axis, for B, the Mohr circle is too small to touch the strength envelope, for C, the Mohr circle is tangential to strength envelope and for D, the Mohr circle is so large that part of the circle is above the strength envelope. Also for the sample C, find the angle made by the failure plane with respect to minor principal plane. (10)

(OR)

b) Following are the results of a triaxial test conducted on two specimens of the same soil. Find the shear strength parameters of the soil. If another specimen of the same soil is subjected to a cell pressure of 400 kPa, find the deviator stress at which it is likely to fail. Also for this specimen, find the normal stress and shear stress on the failure plane and locate the plane of maximum shear stress with respect to major principal plane and find the magnitude of maximum shear stress.

Cell pressure , kPa	100	200
Deviator stress at failure, kPa	300	585

15. a) i) A slope of very large extent of soil with properties c' = 0 and $\phi = 32°$ is likely to be subjected to seepage parallel to the slope with water level at the surface. Determine the maximum angle of slope for a factor of safety of 1.5 treating it as an infinite slope. For this angle of slope what will be the factor of safety if the water level were to come down well below the surface ? The saturated unit weight of soil is 20 kN/m^3. (8)

ii) Discuss about various slope protection measures. (5)

(OR)

b) i) An embankment 10 m high is inclined at 35° to the horizontal. A stability analysis by the method of slices gave the following forces :

Total normal force = 900 kN ; Total tangential force = 420 kN ; Total neutral force = 200 kN. If the length of the failure arc is 23 m, find the factor of safety with respect to shear strength. The soil has c = 20 kN/m^2 and $\phi = 15°$. (8)

ii) Explain friction circle method of slope stability analysis. (5)