Code No: RR320101 **Set No.1**

III B.Tech. II Semester Regular Examinations, April/May -2005
GEOTECHNICAL ENGINEERING
(Civil Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Distinguish between porosity and void ratio.
   (b) Explain clay mineral structure in detail.
2. (a) Write a brief note on 'Proctor's Needle'.
   (b) Derive an expression for 'zero- air -void line' and draw the line for a specific gravity of 2.65.
   (c) Draw typical compaction curves for:
      i. well graded gravel with sand,
      ii. sandy clay, and
      iii. silty clay
3. (a) Define shrinkage limit of a soil.
   (b) How does shrinkage takes place in cohesive soils?
   (c) A saturated specimen of clay has a volume of 0.234 $\times 10^{-3}$m^3 and a weight of 0.4N. On oven drying the weight reduced to 0.3N and the volume reduced to 0.180 $\times 10^{-3}$m^3. Determine the shrinkage limit and specific gravity.
4. (a) What are the different types of soil water. Discuss.
   (b) The following data pertains to the coefficients of permeability of a stratified soil deposit.

Soil	Coefficient of permeability(mm/sec)	Thickness of stratum(m)
A	1×10^{-3}	3
B	2×10^{-4}	4
C	4×10^{-6}	5

   Determine the ratio of coefficients of horizontal permeability to the vertical permeability.
5. (a) Write short notes on :
      i. critical hydraulic gradient
      ii. phreatic line
   (b) In a flownet the number of flow channels is 6 and the number of equipotential drops is 12. The co-efficient of permeability is 3×10^{-3} cm/sec. Calculate the quantity of seepage under a head of 3m.
6. (a) How would you determine the stresses at a point due to

i. Strip load

ii. Circular load.
Compare the zones of influence due to the two types of loads.

(b) A load of 16KN/m^2 is uniformly distributed over a circular area of 6m diameter at the ground surface. Calculate the vertical stress at a point P which is at a depth of 5m directly below the center of the loaded area.

7. (a) The water table in a lake has been lowered by 20m below the bed, will this cause a settlement of a clay layer 5m thick, lying 25m below bed level? Explain.

(b) An oedometer test is performed on a 2cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation be achieved in the field where the clay layer is 3.7m thick? Assume the sample and the clay layer have the same drainage boundary conditions (double drainage).

8. (a) Compute the shear strength of a soil along a horizontal plane at a depth of 5 m in a deposit of sand having the following properties:

Angle of internal friction: 36^0

Dry Unit Weight : 17 kN/m^3

Specific gravity of solids : 2.7

Assume th water table to be at a depth of 2.4 m from the ground level. Also determine the change in the shear strength, if the water table rises up to the ground level.

(b) Discuss briefly the field conditions, which necessitate performing the following tests on soils:

i. Unconsolidated Undrained test

ii. Consolidated Drained test

iii. Consolidated Drained test

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Code No: RR320101 **Set No.2**

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

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1. (a) A soil sample has a bulk unit weight of 21kN/cu.m and the degree of saturation is 80 %. Determine the void ratio and water content if the specific gravity of solids is 2.65.
   (b) Describe the method of obtaining field density of core cutter method.

2. (a) Explain the difference between compaction and consolidation.
   (b) Proctor compaction test was conducted on a soil sample, and the following observations were made:

Water content,%	7.7	11.5	14.6	17.5	19.5	21.2
Weight of wet soil,kg	1.7	1.89	2.03	1.99	1.96	1.92

   If the volume of the mould used was 950c.c and the specific gravity of soil was 2.65, Make necessary calculations and draw
      i. compaction curve and
      ii. 80% saturation line.

3. (a) Describe the Indian Standard Classification at soils.
   (b) A saturated soil mass has a porosity of 40% and specific gravity of 2.6 Determine
      i. Water content
      ii. Dry unit weight
      iii. Saturated Unit weight
   (c) Give maximum values of
      i. Porosity
      ii. degree of saturation
      iii. Relative density

4. (a) For what types of soils do you prefer falling head test and variable head test? why?
   (b) In a falling head permeability test the following results were obtained:
   Length of specimen = 350 mm
   Diameter of stand pipe = 20 mm
   Diameter of sample = 100 mm
   Head at starting of test = 1200 mm
   Time elapsed = 320 sec
   Co-efficient of permeability = 0.03 mm/sec
   Find the height at which the test was terminated.

5. (a) State the basic principle of effective stress. What is its effect on the soil mass?

   (b) A 10m thick sand deposit overlies a bed of soft clay. The water table is 5m from the ground surface. If the sand above the water table has a 45% degree of saturation, calculate the effective stress at the middle and bottom of the sand layer. Take e = 0.68 and Gs = 2.65.

6. (a) How would you determine the stresses at a point due to

      i. Strip load

      ii. Circular load.

      Compare the zones of influence due to the two types of loads.

   (b) A load of 16KN/m^2 is uniformly distributed over a circular area of 6m diameter at the ground surface. Calculate the vertical stress at a point P which is at a depth of 5m directly below the center of the loaded area.

7. (a) Distinguish between normally consolidated and over consolidated soils.

   (b) Explain in detail any one method for determining the coefficient of consolidation of soil.

   (c) The void ratio of a clay is 1.56, and its compression index is found to be 0.8 at Pressure of 180 kN/m^2. What will be the void ratio if the pressure is increased to 240 kN/m^2?

8. (a) What is meant by critical void ratio? Explain the influence of confining pressure on it.

   (b) Direct shear test was carried out on samples of compacted sand. The shear box dimensions were 60 mm x 60 mm. The readings obtained are given below.

Normal load(N)	110	225	340
Peak shear load at failure (N)	95	195	294
Ultimate shear load at failure (N)	65	135	200

   Determine the angle of shearing resistance of the sand

      i. in the dense compacted state

      ii. in a loose state.

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1. (a) Define
   i. submerged unit weight
   ii. Saturated unit weight
   (b) A saturated sample of soil has a water content of 25%. Assuming G =2.70, calculate dry unit weight, saturated density and submerged unit weight.
   (c) With usual notations prove that
   $\gamma_b = \frac{(G+eS)\gamma_w}{1+wG}$
2. (a) Write a brief note on 'Proctor's Needle'.
   (b) Derive an expression for 'zero- air -void line' and draw the line for a specific gravity of 2.65.
   (c) Draw typical compaction curves for:
   i. well graded gravel with sand,
   ii. sandy clay, and
   iii. silty clay
3. (a) Define uniformity co-efficient and co-efficient of curvature.
   (b) With a neat schematic graph explain the different states of soils at different water content.
4. (a) Explain the laboratory experiment used to determine the coefficient of permeability of the fine grained soils.
   (b) A permeameter 80 mm diameter with a sample length of 300 mm has been used for constant head and falling head tests. While conducting a constant head test, the loss of head was 1150 mm for a length of 300 mm and the rate of flow was 2700 mm^3/sec. If a falling head test was then performed on the same sample at the same void ratio, find the time taken for the head to fall from 900 to 450 mm. The diameter of standpipe was 25 mm.
5. (a) Write short notes on :
   i. critical hydraulic gradient
   ii. phreatic line
   (b) In a flownet the number of flow channels is 6 and the number of equipotential drops is 12. The co-efficient of permeability is 3×10^{-3} cm/sec. Calculate the quantity of seepage under a head of 3m.

6. (a) How would you determine the stresses at a point due to
   i. Strip load
   ii. Circular load.
   Compare the zones of influence due to the two types of loads.
   (b) A load of 16KN/m^2 is uniformly distributed over a circular area of 6m diameter at the ground surface. Calculate the vertical stress at a point P which is at a depth of 5m directly below the center of the loaded area.

7. (a) Bring out the points of difference between compectives and consolidations.
   (b) A normally consolidated clay layer of 10 m thickness has a unit weight of 20 kN/m^3 and specific gravity 2.72. The liquid limit of the clay is 58%. A structure constructed on this clay increase the overburden by 10%. Estimate the ultimate consolidation settlement. There is no secondary compression.

8. A soil sample is initially subjected a cell pressure of 100 kPa. Draw stress paths for the loading conditions, when
   (a) the cell pressure is kept constant and the major principal stress is increased to 200 kPa,
   (b) both cell pressure and major principal stress are increased to 200 kPa
   (c) major principal stress is maintained constant and cell pressure is increased to 200 kPa
   (d) major principal stress is kept constant while the cell pressure is decreased to 25 kPa.

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1. (a) What is meant by cation exchange capacity of clays? List the cations in the order of their increasing replacing power. Explain the significance of cation exchange. Give typical values of cation exchange capacities of kaolinite,illite and montomorillonite clay minerals.

   (b) The maximum and minimum dry unit weights of sand,determined in the laboratory,are 2g/cc(20kN/m^3)and 1.5g/cc(15kN/m^3) respefctively. If the relative density of sand is 74%,determine the insituporosity of sand deposit.Assume G=2.6.

2. (a) What are the methods adopted for determining the density of soil in the field? Explain any one method and its limitations.

   (b) An earth embankment is to be compacted to a density of 19 kN/ m^3 at a moisture. Content of 14%. The in-situ bulk density and water content of the borrow pit are 18 kN/m^3 and 8% respectively. How much excavation should be carried out from the borrow pit for each m of the embankment?

3. (a) Liquid limit test on a given sample gave the following values.

Water content %	70	64	47	44
No of Biows N	5	8	30	45

   Plot the values on Semi-log sheet and determine the liquid limit and flow index.

   (b) Describe the procedure to obtain plastic limit of a soil.

4. (a) Mention two different methods of determining the permeability coefficient of a soil. Explain when you prefer each of them.

   (b) Write a note on factors affecting permeability.

5. (a) Derive the Laplace equation for two dimensional flow, mentioning the assumptions made there in.

   (b) Write short notes on flownets.

6. (a) Derive the Boussinesq equations of vertical stress and tangential stress for a concentrated force.

   (b) A circular area of 7.5 metres in diameter on the ground surface carries a uniformly distributed load 3 kN/^{2}. Find the intensity of vertical pressure below the center of the loaded area at a depth of 6 meters below the ground surface. Use Boussinesq analysis.

7. (a) The water table in a lake has been lowered by 20m below the bed, will this cause a settlement of a clay layer 5m thick, lying 25m below bed level? Explain.

   (b) An oedometer test is performed on a 2cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation be achieved in the field where the clay layer is 3.7m thick? Assume the sample and the clay layer have the same drainage boundary conditions (double drainage).

8. (a) Explain which type of triaxial test you would recommend on soil in the following cases, giving reasons:

   i. Stability of up and downstream slopes of an earth dam

   ii. A raft foundation on clay

   iii. An airport runway.

   (b) In a drained triaxial test on a dense sand, the cell pressure was 150kPa and the deviator stress to cause failure was 540kPa. Calculate the angle of internal friction. Also find the angle made by the failure plane with respect to major principal plane.

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