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Question Paper Code : 23225

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fourth Semester

Civil Engineering

CE 1251/CE 1252/070100029 — MECHANICS OF SOILS

(Regulation 2004/2007)

(Common to B.E. (Part-Time) Third Semester, Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Can liquid limit of any soil be more than 100 %? Substantiate your answer.

2. A dry clay has a mass of 30 g and volume of 15 cc, find its shrinkage limit if the specific gravity of solids is 2.65.

3. The coefficient of permeability of a soil is found to be 1×10^{-5} m/s at a void ratio of 0.6. Find its coefficient of permeability at void ratio of 0.4, the other factors remaining the same.

4. Say true or false and justify your answer : In fine-grained soils the capillary rise is less compared to coarse-grained soils.

5. A Newmark's chart is drawn for z = 50 mm. Find the radius of the circle corresponding to $\sigma_z / q = 0.1$ and $\sigma_s / q = 0.2$ respectively (σ_z and q are additional vertical pressure and applied loading intensity respectively).

6. A consolidating stratum takes two years for 50 % consolidation. Find the time taken by the stratum for 90% consolidation and 100% consolidation respectively 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 failure for the results of a triaxial test performed on a soil is the same and equal to 200 kPa to a scale. Find the shear strength parameters.

9. What is meant by 'Base failure'? When does it occur?

10. What are the three critical conditions for which the stability analysis of an earth dam is carried out?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Particles of five different sizes are mixed in the proportions shown in the following table and enough water is added to make a 1000-cc suspension.

Size, mm :	0.050	0.020	0.010	0.005	0.001
Weight, N :	0.06	0.20	0.15	0.05	0.04

It is ensured that the suspension is thoroughly mixed so as to have a uniform distribution of particles. What would be the hydrometer reading after five minutes since the start of sedimentation analysis if the centre of the hydrometer bulb is at a depth of 60 mm? Take specific gravity of solids and dynamic viscosity of water as 2.7 and 1×10^{-3} N.s/m^2 respectively. Ignore all the corrections in the hydrometer reading. (12)

(ii) The classification tests conducted on a soil yielded the following results. Classify the soil as per IS 1498

Percentage of gravel		:	72
Percentage of sand		:	24
Size corresponding to	10% finer	:	1.6 mm
	30% finer	:	4.0 mm
	60% finer	:	8.0 mm

(4)

Or

(b) (i) A soil sample was collected in a sampling tube of internal diameter 50 mm. The length of the extracted sample was 102 mm and its mass was 387 g. If the specific gravity of solids is 2.7 and the mass of the dried sample is 313 g, find porosity, void ratio, degree of saturation and dry density of soil. (8)

(ii) The compaction of an embankment is carried out in 150 mm thick lifts (layers). The rammer used for compaction has foot area of 0.05 m^2. The energy developed per drop of the rammer is 300 J. Assuming 50 % more energy in each pass over the compacted area due to overlap, calculate the number of passes required to develop compactive energy equivalent to IS light compaction for each layer. (8)

12. (a) For the soil profile given in the Fig. 12 (a), compute the effective pressure at the middle of the clay layer. The thickness of fine sand, silt, peat and clay is respectively 3m, 3m, 4m and 4m. The ground water table is at 4m from the ground level. The degree of saturation of silt above the water table is 80%. (G, n, S, e and w assume usual notations) (16)

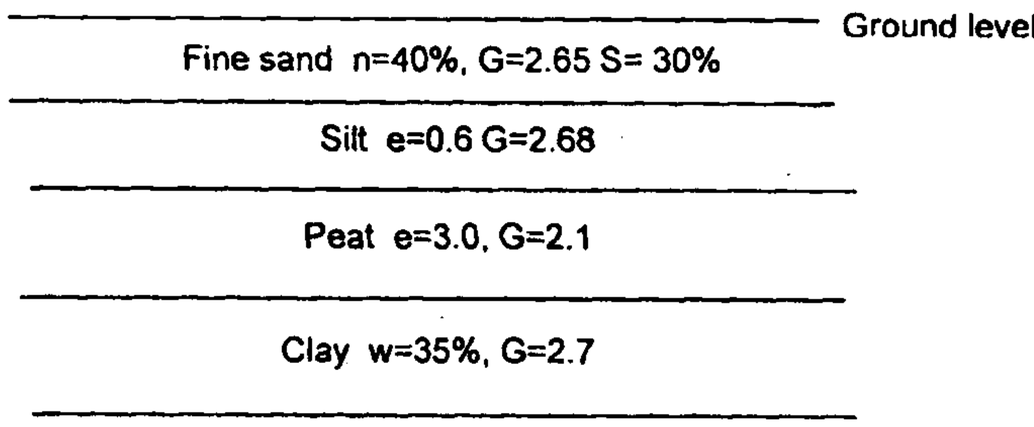

Fig. 12 (a)

Or

(b) A sand deposit 12 m thick overlies an impermeable stratum. A weir is founded at a depth of 2 m from the ground level. The difference in water level between the upstream and downstream sides of the weir is 6 m. The sand has a vertical coefficient of permeability of 1×10^{-4} m/s and horizontal coefficient of permeability equal to 9 times that in the vertical direction. The flow net drawn for the weir shows 4 flow channels and 12 equipotential drops. Determine the volume of water seeping through the soil per day per metre length of the weir.
If the minimum length of flow line between the last two consecutive equipotential drops near the exit is 0.8 m and saturated unit weight of the sand is 19.62 kN/m^3, find the available factor of safety against the development of quick sand condition. (16)

13. (a) A square foundation of size 3.6m for a water tank carries a load of 9000 kN. It rests on a 9m thick dense sand overlying a 3m thick clay layer. The clay layer overlies hard rock. The liquid limit, water content and specific gravity of solids of the clay are 54%, 40.5% and 2.7 respectively. The saturated unit weight of the dense sand is 19.81 kN/m^3. Estimate the probable consolidation settlement of the clay layer, assuming the site to be flooded. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units). (16)

Or

(b) (i) A ring type foundation of outer diameter 8 m and inner diameter 6 m is subjected to a pressure of 100 kPa at its base. Find the additional vertical stress at a depth of 5 m below the base along its central line. (5)

(ii) 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 specific gravity of solids is 2.7. Between ground surface and the clay, the subsoil consists of fine sand. The water table is at a depth of 4m below the

ground surface. The average submerged unit weight of sand is 10.5kN/m^3 and the unit weight of sand above the water table is 17kN/m^3. The weight of the building that will be constructed on the sand above the clay increases the average overburden stress on the clay by 40 kPa. Estimate the probable settlement of the clay layer. (11)

14. (a) (i) Following are the results of Unconsolidated Undrained 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 were subjected to unconfined compression test, find the expected unconfined compressive strength and the angle made by failure plane with respect to major principal plane. (12)

Cell pressure kPa :	100	200
Deviator stress at failure kPa :	233	275

(ii) Discuss the limitations of direct shear test (4)

Or

(b) (i) Following are the results of a shear box test on a soil.

Normal stress, kPa :	25	75	150	250
Shear stress at failure, kPa	60	80	105	145

Determine the shear strength parameters. If a specimen of the same soil is tested in a triaxial apparatus, find the deviator stress at which the sample will fail under a cell pressure of 100 kPa. (12)

(ii) The sand in a deep deposit has an angle of internal friction of 350, a dry unit weight of 18.5 kN/m^3 and saturated unit weight of 20 kN/m^3. If the water table is at a depth of 2 m from ground level, what is the shearing resistance of the soil to sliding from the ground level? Assume the sand to be dry above the water table. (4)

15. (a) (i) An embankment 10 m high is inclined at angle of 40° to the horizontal. A slip circle method analysis gives the following forces per running metre.

Σ Shearing forces	=	450 kN
Σ Normal forces	=	873 kN
Σ Neutral forces	=	218 kN

The length of the failure arc is 22.0 m. Soil tests in the laboratory internal friction is 15° and cohesion is 20 kPa.

Find the factor of safety with respect to Shear strength and Cohesion respectively. (8)

(ii) Explain the friction circle method of slope stability analysis for a $c - \phi$ soil. (8)

Or

(b) Derive from the first principles, the factor of safety of an infinite slope made of (i) Cohesionless soil (ii) $c - \phi$ soil. (16)
