15. a) A new canal is excavated to a depth of 5 m with banks having a slope angle of 60° with horizontal. The properties of the soil are : cohesion = 15 kPa, angle of internal friction = 21°.3,, void ratio = 0.859 and specific gravity of solids = 2.65. Calculate the factor of safety with respect to cohesion when there is a sudden draw down. If a factor of safety of 1.5 is desired, find the safe slope angle. The table of Taylor's stability number is given below.

i \ φ	0°	5°	10°	15°	20°	25°
90°	0.261	0.239	0.218	0.199	0.182	0.166
75°	0.219	0.195	0.173	0.152	0.134	0.117
60°	0.191	0.162	0.138	0.116	0.097	0.079
45°	0.170	0.136	0.108	0.083	0.062	0.044
30°	0.156	0.110	0.075	0.046	0.025	0.009
15°	0.145	0.068	0.023	–	–	–

(OR)

b) An infinite slope of soil having cohesion of 30 kPa, unit weight of 18 kN/m^3 and angle of internal friction of 20° has slope angle of 30°. Determine the critical height of the slope. Derive the equation used, if any.

PART – C **(1×15=15 Marks)**

16. a) An unconfined compression test was conducted on an undisturbed specimen of a soil, 38 mm in diameter and 80 mm in length. The weight of the specimen was 1.8 N. It failed under an axial load of 125 N when the axial deformation was 7 mm.The failure plane was inclined at 50° to the horizontal. After oven-drying the weight of the specimen reduced to 1.5 N. Take specific gravity of solids as 2.65. Determine : (i) water content (ii) bulk unit weight (iii) dry unit weight (iv) saturated unit weight (v) void ratio (vi) degree of saturation (vii) shear strength parameters.

(OR)

b) Deduce the expression for Boussinesq's vertical stress at a depth of 'z' along the central line of a circular area of radius 'R' subjected to a uniformly distributed load of 'q' from the equation for point load case and hence find the vertical stress at a depth of 3 m below the base of a circular ring type foundation with inner diameter 5 m and outer diameter 8 m subjected to a loading intensity of 100 kPa.

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

Question Paper Code : 90128

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/ DECEMBER 2019
Fourth/Fifth Semester
Civil Engineering
CE 8491 – SOIL MECHANICS
(Common to Environmental Engineering)
(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. In a wet sieve analysis performed on a 50-g dry soil, the mass of dry fraction retained on 75 micron sieve is 22 g. If the liquid limit and plastic limit of the soil are 19% and 13% respectively, classify the soil as per IS 1498.
2. What is meant by 'Specific surface area' ? What is its influence on Optimum Moisture Content ?
3. Why is falling head permeability test preferred to constant head test for fine-grained soils ?
4. In a flow net, the number of flow channels and the number of equipotential lines are respectively 4 and 9. If the coefficient of permeability and loss of head are 9×10^{-8} m/s and 1 m respectively, find the discharge per metre run.
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. Under a certain loading, a saturated clay layer undergoes 50% consolidation in 200 days. What would be the additional time required for further 40% consolidation to occur ?
7. A purely cohesive soil sample of cohesion 25 kPa is subjected to a cell pressure of 100 kPa in a triaxial test. Will the sample fail by shear ? Justify your answer.

8. Why is unconfined compression test conducted at a fast strain rate ?
9. When does the base failure take place in a finite slope ?
10. A 4-m deep vertical cut is made in a purely cohesive soil of unconfined compressive strength of 60 kPa and unit weight of 19 kN/m^3. Find the available factor of safety with respect to cohesion.

PART – B **(5×13=65 Marks)**

11. a) i) A 1000-cc suspension is made with 50 g of fine grained fraction of a soil for a hydrometer test. If the magnitude of meniscus correction is 0.001 and the temperature correction is zero, what should be the hydrometer reading corresponding to upper meniscus if it is immersed immediately after the process of sedimentation begins ? Take specific gravity of solids as 2.50. Also, find the volume of the hydrometer if its mass is 75 g. **(9)**

ii) A sample of sand has a volume of 1000 cc in natural state. Its volume at the densest and loosest possible states is 840 cc and 1370 cc respectively. Determine the relative density. **(4)**

(OR)

b) i) The liquid limit and shrinkage limit of a soil are 40% and 12% respectively. If the volume of a saturated specimen at the liquid limit is 20 cm^3 and the specific gravity of solids is 2.65, find the volume of the specimen at shrinkage limit. Also, determine the degree of saturation at a moisture content (i) 12% (ii) 8% **(10)**

ii) The results of one of the trials of heavy Compaction test performed on a soil having specific gravity of solids of 2.7 are given below :

Moisture content : 12%

Bulk unit weight : 22.62 kN/m^3

What is the discrepancy in the above data ? **(3)**

12. a) A soil in a location consists of clay upto a depth of 4 m from the ground level underlain by sand. The water table is at 2 m below the ground level. The specific gravity of solids and void ratio of the clay are 2.62 and 0.9 respectively. The water content of the clay above the water table is 20%. The unit weight of sand is 19.81 kN/m^3. Draw the total neutral and effective stress diagrams upto a depth of 8 m below the ground level.

(OR)

b) A 3-m thick uniformly graded sandy stratum has an effective size of 0.1 mm. A separate test gave a porosity of 40% and bulk unit weight of 19.64 kN/m^3 at a moisture content of 25%. Determine the head at which upward seepage will cause a quicksand condition. Also find the coefficient of permeability, coefficient of percolation, discharge velocity and seepage velocity under the quicksand condition.

13. a) i) Two footings 6 m apart (c/c distance) at the same level carry concentrated loads of 1000 kN and 1500 kN respectively. Compute the vertical pressure vertically below the centre of each footing at a depth of 3 m below the footing level. **(7)**

ii) Explain the procedure suggested by Casagrande for obtaining preconsolidation pressure from e-log p curve. **(6)**

(OR)

b) At a building site the soil profile consists of sand for the top 5 m underlain by 3 m thick normally consolidated clay. The clay layer is underlain by an impermeable rock. The ground water table is 2 m below the existing ground level. The unit weights of sand above and below water table are 19.5 kN/m^3 and 20 kN/m^3 respectively. The initial void ratio, specific gravity of solids and liquid limit of the clay are 1.59, 2.7 and 70% respectively. Estimate the probable settlement of the clay layer, if the ground level is raised by a 2-m thick fill of sand of unit weight 19 kN/m^3. The area of loading is 15 m × 30 m. Adopt 2:1 dispersion method for the calculation of additional stress.

14. a) A sample of cohesionless sand in a direct shear test fails under a shear stress of 62.5 kPa when the normal stress was 100 kPa. Find the angle of shearing resistance of the sand. Find the principal stresses and locate the principal planes. Also, find the maximum shear stress.

(OR)

b) Following are the results of Consolidated Drained triaxial test conducted on two specimens of the same soil. The diameter and length of the samples are respectively 38 mm and 85 mm. Find the shear strength parameters of the soil.

Specimen No.	1	2
Cell Pressure, kPa	100	200
Deviator load at failure, N	488	788
Decrease in volume at failure, cm^3	8.0	12.0
Axial compression at failure, mm	5.0	7.0