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**Question Paper Code : 20330**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

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 saturated soil mass, compute porosity when its Specific Gravity is 2.62 and water content is 20.5%.

2. State the factors affecting field compaction.

3. Explain the phenomenon called as 'Quick sand Condition'.

4. State Darcy's Law.

5. Define stress isobar.

6. If $r/z=1.5$, find Westergaard's influence factor Kw and Boussinesq influence factor KB.

7. State the demerits of Direct Shear Test.

8. Draw Mohr's circle for unconfined undrained compression strength test.

9. Sketch the types of failures in finite slopes.

10. Distinguish finite and infinite slopes.

PART B — (5 × 13 = 65 marks)

11. (a) With a neat sketch explain the different field compacting equipments with reference to their suitability to different soils.

Or

(b) In a sieve analysis conducted on a sandy soil, the following results were obtained

| Sieve size, mm | 4.75 | 2.36 | 1.18 | 0.6 | 0.30 | 0.15 | 0.075 | Pan |
|---|---|---|---|---|---|---|---|---|
| Weight of soil retained, *g* | 40.2 | 219.8 | 100.5 | 49.5 | 40.6 | 19.4 | 10.3 | 19.7 |

Draw grain size distribution curve. Find the percentages of gravel, sand and fine grained fraction.

12. (a) Calculate the coefficient of permeability of a soil sample 60mm in height and 5000 mm² in cross sectional area, if the quantity of water passed down is equal to 450 cc in 10 minutes under an effective constant head of 400 mm. On oven drying, the test specimen had a mass of 495 g. Taking the specific gravity of solids as 2.65. Calculate the seepage velocity of water during the test.

Or

(b) With a neat sketch distinguish confined and unconfined aquifers.

13. (a) Explain the construction of Newmark's Influence Chart with an influence value of 0.005.

Or

(b) (i) A water tank is supported by a ring foundation having outer diameter of 10 m and inner diameter of 7.5 m. The ring foundation transmits uniform load intensity of 160 kN/m². Compute the vertical stress induced at a depth of 4 m, below the centre of ring foundation. (6)

(ii) Derive Boussinesq's equation for stress analysis under a point load. (7)

14. (a) Two identical specimens of 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 of 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.

Or

(b) With a neat sketch explain how shear strength of soil is estimated using Tri axial Compression test.



15. (a) Describe how using Friction Circle Method, slope stability analysis is carried out.

Or

(b) A canal is to be excavated through a soil with c = 15 kNm², $\varphi = 20^\circ$, e = 0.9 and G = 2.67. The side slope is 1 in 1. The depth of the canal is 6 m. Determine the factor of safety with respect to cohesion when the canal runs full. What will be the factor of safety if the canal is rapidly emptied?

PART C — (1 × 15 = 15 marks)

16. (a) A proposed embankment fill requires 10,000 m³ of compacted soil with a bulk density of 1.92g/cc and placement water content of 20%. Soil from the burrow area is to be excavated and transported to the site in trucks of 5 m³ capacity. During the excavation and dumping of soil in the trucks, the volume of the soil is increased by 15%. At the site, required additional amount of water is added to the soil and compacted to the desired extent by a suitable roller. The properties and cost of soil per truck from the two potential burrow areas are given below.

| Burrow area | In-situ void ratio | In-situ water content % | Specific Gravity of soil Solids | Cost/truck volume, Rs. |
|---|---|---|---|---|
| A | 0.78 | 18.0 | 2.68 | 500 |
| B | 0.7 | 15.0 | 2.68 | 650 |

If the cost of water per m³ is Rs. 50, choose the burrow area from where soil should be used for embankment so that the overall cost is minimized.

Or

(b) (i) Two clay specimens A and B, of thickness 2 cm and 3 cm, have equilibrium voids ratio of 0.68 and 0.72 respectively under a pressure of 200 kN/m². If the equilibrium voids ratio of the two soils reduced to 0.50 and 0.62 respectively, when pressure was increased to 400 kN/m², find the ratio of the co-efficients of permeability of the two specimens. The time required by the specimen A to reach 40% degree of consolidation is 1/4 of that required by specimen B for reaching 40% degree of consolidation.

(ii) A square footing of size 2 m carrying a load of 1000 kN is laid on a sandy soil of thickness 4 m at a depth of 1 m below the ground level. The water table is at 2 m from the ground level. The unit weight of sand above and below water table is 16 kN/m³ and 19.81 kN/m³ respectively. The sand is underlain by a clayey layer of thickness 3 m. The natural water content, specific gravity and liquid limit of the clay are 40%, 2.7 and 60% respectively. The clay is underlain by rock. Find the consolidation settlement of the clay layer. There is geological evidence that the clay is normally consolidated. Use 2:1 dispersion method to estimate the stress increase in the clay layer.

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