B. E. Third Semester (Civil Engineering) / SoE – 2018 Examination

Course Code : CV 2203 **Course Name : Geotechnical Engineering**

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) All questions carry marks as indicated.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Illustrate your answers wherever necessary with the help of neat sketches.

1. (A) (A1) An oven dry soil sample of volume 250 cc weighs 430 g. If the specific gravity of soil is 2·70, what is the water content when the soil becomes fully saturated without any change in its volume ? What will be the water content which will fully saturated the sample and also cause an increase in volume equal to 10% of the original dry volume ? Use phase diagrams. 4 (CO 1, 2) (PO 1, 2)

(A2) Establish the expression for bulk unit weight for soil in terms specific gravity, void ratio and degree of saturation. With the help of Three – phase diagram. 4 (CO 1, 2) (PO 1, 2)

(A3) Explain field of Geotechnical engineer in construction industry. 2 (CO 1) (PO 1)

OR

(B) (B1) A soil has bulk density of 20·1 kN/m^3 and water content of 15%. Calculate the water content if the soil partially dries to a density of 19·4 kN/m^3 and the void ratio remains unchanged, Also find the density when the soil is completely saturated. 4 (CO 1, 2) (PO 1, 2)

(B2) The total unit weight of the soil is 16 kN/m^3. The specific gravity of soil particles is 2·67. The water content of the soil is 17%, Determine the dry unit weight, void ratio, porosity and degree of saturation. 4 (CO 1, 2) (PO 1, 2)

(B3) Explain difference between residual and transported soil. 2 (CO 1) (PO 1)

2. (A) (A1) The plastic limit and liquid limit of a soil are 33% and 45% respectively. The percentage volume charge of from the liquid limit to the dry state is 36% of the dry volume. Similarly the percentage volume change from the plastic limit to the dry state is 24% of the dry volume. Determine the shrinkage limit and shrinkage ratio. 4 (CO 1, 2) (PO 1, 2, 4)

(A2) Explain Relative density. A granular soil (sand) was tested in the laboratory and found to have maximum and minimum void ratios of 0·84 and 0·38, respectively. The value of specific gravity was determined to be 2·65. A natural soil deposit of same sand has 9% water content, and its unit weight is 18·64 KN/m^3. Determine the dry density of the soil in the field. 4 (CO 1, 2) (PO 1, 2, 4)

(A3) Define :

(i) Effective size.

(ii) Uniformity coefficient.

(iii) Coefficient of curvature. 2 (CO 1) (PO 1)

OR

(B) (B1) Explain I.S classification of soil. 4 (CO 1, 2) (PO 1, 2, 4, 11)

(B2) The consistency limits of a soil sample are :

(i) Liquid limit = 52%.

(ii) Plastic limit = 32%.

(iii) Shrinkage limit = 17%.

If the specimen of this soil shrinks from a volume of $10\ cm^3$ at liquid limit to $6{\cdot}01\ cm^3$ at the shrinkage limit, calculate the specific gravity of soil. 4 (CO 1, 2)
(PO 1, 2, 4, 11)

(B3) Explain and Sketch typical grain size distribution curves for :

(i) Well graded soil.

(ii) Uniform silty sand.

(iii) Poorly graded soil. 2 (CO 1, 2)
(PO 1, 2, 4, 11)

3. (A) (A1) A constant head permeability test was run on a sand sample 16 cm in length and $60\ cm^2$ in cross – sectional area. Porosity was $n_1 = 40\%$. Under a constant head of 30 cm, the discharge was found to be $45\ cm^3$ in 18 seconds. Calculate the coefficient of permeability. Also, determine the discharge velocity and seepage velocity during the test. Estimate the permeability of sand for a porosity of $n_2 = 35\%$. 4 (CO 1, 2)
(PO 1, 2, 3, 4, 11)

(A2) Derive and explain Darcy's law. 4 (CO 1, 2)
(PO 1, 2, 3)

(A3) Explain the application of flow net. 2 (CO 1, 2)
(PO 1, 2, 3, 4, 11)

OR

(B) (B1) Explain 'Quicksand condition'. Give the expression for critical hydraulic gradient. 4 (CO 1, 2)
(PO 1, 2, 3, 4, 11)

(B2) Explain Factors affecting permeability of soil. 4 (CO 1, 2)
(PO 1, 2, 3, 4, 11)

(B3) Explain coefficient of permeability in horizontal and vertical direction.
2 (CO 1, 2)
(PO 1, 2, 11)

4. (A) (A1) Explain Isobar diagram with an example for $\sigma_z = 25\%\,Q$.
4 (CO 3)
(PO 1, 2, 3, 11)

(A2) A rectangular area $4\,m \times 6\,m$ carries a uniformly distributed load of $150\,kN/m^2$ at the ground surface. Find the intensity of vertical pressure at a depth of 2·5 m below a point 0·5 m inside each of the two adjacent sides of the footing. 4 (CO 3)
(PO 1, 2, 3, 11)

(A3) Explain the use of Newmark's influence chart. 2 (CO 3)
(PO 1, 2, 3, 11)

OR

(B) (B1) Two column A and B are standing 5 m apart. Load transferred through them may be taken as point load. Through **column A load of 400 kN** and **column** B load of 750 kN are acting. Calculate the resultant vertical pressure due to these load on a horizontal plane 2 m below the ground surface at points vertically below the column A and B. Also draw the pressure distribution diagram. 4 (CO 3)
(PO 1, 2, 3, 11)

(B2) Derive Bossinesq's equation for vertical stress and shear stress due to point load. 4 (CO 3)
(PO 1, 2, 3, 11)

(B3) Explain point load method. 2 (CO 3)
(PO 1, 2, 3, 11)

5. (A) (A1) Compression index and Coefficient of consolidation. 4 (CO 4)
(PO 1, 2, 11)

(A2) Define the 'pre – consolidation pressure'. Describe the procedure for determining the pre – consolidation pressure. 4 (CO 4)
(PO 1, 2, 3, 11)

(A3) The maximum dry density of sample by the light compaction test is 1·78 g/m*l* at an OMC of 15%. Find the air voids and degree of saturation if G = 2·67. What would be the corresponding value of dry density on zero void line at OMC ? 2 (CO 4)
(PO 1, 2, 3, 4, 11)

OR

(B) (B1) Explain the factors affecting compaction in detail. 4 (CO 4) (PO 1, 2, 3, 11)

(B2) An undisturbed sample of clay stratum 4 m thick was tested in the laboratory and the average value of the coefficient of consolidation was found to be $2 \times 10^{-4}\ cm^2/sec$. If the structure is build on the clay stratum how long will it take to attain half the ultimate settlement under the load of structure ? Assume double drainage. 4 (CO 4) (PO 1, 2, 3, 11)

(B3) Explain field compaction equipment with their suitability. 2 (CO 4) (PO 1, 11)

6. (A) (A1) Explain Vane shear test. 4 (CO 5, CO 4) (PO 1, 11)

(A2) Following are the results of triaxial test on two identical soil specimens at failure :

Lateral Pressure σ_3 (kN/m^2)	100	200	300
Deviator Pressure σ_d (kN/m^2)	600	750	870

Determine the cohesion and angle of internal friction. 4 (CO 5) (PO 1, 2, 3, 4, 11)

(A3) Explain the Mohr – Coulomb's strength envelope. 2 (CO 5) (PO 1, 2, 11)

OR

(B) (B1) A soil specimen when tested in unconfined compression test fails at axial test of 120 kN/m^2 the same sample tested in tri – axial compression test. The failure occurs at cell pressure of 40 kN/m^2 and axial deviator stress of 160 kN/m^2. Determine shear strength parameter. 4 (CO 5) (PO 1, 2, 3, 4, 11)

(B2) The following result were obtained from an untrained shear box on a soil :—

Normal Load (N)	Failure Load (N)
250	320
500	460
750	610

Determine the share strength parameter in terms of total stresses. The cross sectional area of the shear box was 36 cm^2.

4 (CO 5)
(PO 1, 2, 3, 4, 11)

(B3) Describe the limitations of direct shear test. 2 (CO 5)
(PO 1, 2, 3, 4, 11)