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## Fifth Semester B.E. Degree Examination, July/August 2022 Basic Geotechnical Engineering

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. With the help of 3-phase diagram define: void ratio, porosity, water content and degree of saturation. (08 Marks)
- b. Derive from first principles, the following phase relation:  

$$\gamma_d = \frac{(1 - n_a)G \cdot \gamma_w}{1 + wG}$$
 (06 Marks)
- c. With the help of particle size distribution curve explain well graded soil, uniformly graded soil and gap graded soil. (06 Marks)

OR

- 2 a. Explain plasticity chart with a neat sketch and its use in classification of fine grained soil. (08 Marks)
- b. How many cubic meters of soil can be formed with a void ratio of 0.5 from 100 cubic meters of soil having void ratio of 0.7? (06 Marks)
- c. A soil sample consisting of particles size ranging from 0.5mm to 0.01mm is put on the surface of still water tank 5 mts deep. Calculate the time of settlement of the coarsest and finest particles of the sample to the bottom of the tank. Assume average specific gravity of soil particles as 2.66 and viscosity of water as 0.01 poise. (06 Marks)

### Module-2

- 3 a. Explain with sketches the various soil structures. (06 Marks)
- b. Explain any two clay minerals with the help of neat sketches. (08 Marks)
- c. List and explain the factors affecting compaction. (06 Marks)

OR

- 4 a. What are the differences between standard and modified Proctor's compaction tests? (06 Marks)
- b. Explain Electrical diffused double layer and adsorbed water. (06 Marks)
- c. The observations of a standard Proctor's compaction test are as follows:

Dry density kN/m <sup>3</sup>	16.16	17.06	18.61	18.95	18.78	17.13
Water content, %	5	8.81	11.25	13.05	14.40	19.25

Plot the compaction curve and determine OMC and  $\gamma_{d \max}$ . Also compute void ratio and degree of saturation at optimum condition. Take  $G = 2.77$ . (08 Marks)

### Module-3

- 5 a. Define Darcy's law. Derive the relationship between discharge velocity and seepage velocity. (06 Marks)
- b. Derive an expression to obtain coefficient of permeability under falling head condition. (06 Marks)
- c. A clay structure of thickness 8m is located at a depth of 6m below the ground surface. It is overlaid by fine sand and the water table is located at a depth of 2m below ground surface. For fine sand submerged unit weight is 10.2kN/m<sup>3</sup>. The moist unit weight of sand located above water table is 16kN/m<sup>3</sup>. For clay layer  $G = 2.76$  and  $w = 25\%$ . Compute the effective stress at the middle of clay layer. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.



OR

- 6 a. What is a flownet? Briefly explain the characteristics and uses of flownets. (08 Marks)  
 b. Explain the terms: Total stress, effective stress and neutral stress. (06 Marks)  
 c. Calculate the coefficient of permeability of a soil sample, 6 cms in height and  $50\text{cm}^2$  in cross-sectional area, if a quantity of water equal to 430cc passed down in 10 minutes, under an effective constant head of 40cms. On oven drying the test specimen has a mass of 498gms. Taking the specific gravity of soil solids as 2.65, calculate the seepage velocity of water during the test. (06 Marks)

**Module-4**

- 7 a. Explain Mohr-Coulomb theory of shear strength. (06 Marks)  
 b. Explain the advantages and disadvantages of direct shear test over triaxial shear test. (06 Marks)  
 c. An unconfined compression test was conducted on an undisturbed sample of clay. The sample had a diameter of 38mm and was 80mm long. The load at failure was measured as 30N and the axial deformation of the sample at failure was 12mm. Determine the unconfined compressive strength and undrained shear strength of clay. (08 Marks)

OR

- 8 a. Explain sensitivity and thixotropy. (06 Marks)  
 b. Explain Vane shear test with a neat sketch. (06 Marks)  
 c. The triaxial tests carried out on soil samples gave the following results:

Confining Pressure., $\text{kN/m}^2$	50	100	150
Deviator stress, $\text{kN/m}^2$	76	132	186
Pore water Pressure., $\text{kN/m}^2$	35	59	83

Plot Mohr's circle and obtain effective shear parameters. (08 Marks)

**Module-5**

- 9 a. Explain spring analogy theory of consolidation of soil. (06 Marks)  
 b. What is preconsolidation pressure? How it is determined by Casagrande's graphical method? (06 Marks)  
 c. An undisturbed sample of clay, 24mm thick, consolidated 50% in 20 minutes, when tested in laboratory with drainage allowed at top and bottom. The clay layer from which the sample was obtained is 4m thick in field. How much time will it take to consolidate 50% with double drainage? If the clay stratum has only single drainage, calculate the time to consolidate 50%. Assume uniform distribution of consolidation pressure. (08 Marks)

OR

- 10 a. Explain pre consolidated, normally consolidated and underconsolidated soil. (06 Marks)  
 b. With a neat sketch, explain the square root of time fitting method of determining coefficient of consolidation. (06 Marks)  
 c. In a consolidation test the void ratio of soil sample decreases from 1.20 to 1.10, when the pressure is increased from 160 to  $320\text{kN/m}^2$ . Determine coefficient of consolidation if the coefficient of permeability is  $8 \times 10^{-7}\text{mm/s}$ . (08 Marks)

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