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18CV54

Fifth Semester B.E. Degree Examination, Feb./Mar. 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. Define the following:
 (i) Water content (ii) Void ratio
 (iii) Unit weight of soil (iv) Density index (06 Marks)
- b. Prove the relation $\gamma_{dry} = \frac{G\gamma_w}{1+e}$ and $S_e = wG$ from basic principles. (08 Marks)
- c. A soil has a bulk unit weight of 26 kN/m^3 , $G = 2.76$ and water content 16%. Determine the dry unit weight, void ratio, porosity and degree of saturation. What is the unit weight if the soil gets fully saturated due to rain? (06 Marks)

OR

- 2 a. With the help of the phase diagram, define the terms bulk density, dry density, degree of saturation and specific gravity of soil solids. (08 Marks)
- b. Following are the results obtained from the tests conducted on two soils A and B. Classify them as per IS classification system. Explain the steps involved.

| Soil | W_L (%) | W_P (%) | % retained on 75 μ sieve | % retained on 4.75 mm Sieve | C_u | C_c |
|------|-----------|-----------|------------------------------|-----------------------------|-------|-------|
| A | 110 | 50 | 40 | Zero | - | - |
| B | - | - | 92 | 05 | 0.7 | 0.2 |

- c. Explain the determination of specific gravity of soil solids by pycnometer method. (06 Marks)

Module-2

- 3 a. Explain different types of soil structures. (08 Marks)
- b. Discuss the factors affecting compaction in detail. (06 Marks)
- c. Determine the relative compaction of soil if the field density is 18.51 kN/m^3 ; whose HDD is 22 kN/m^3 and OMC is 13%. Comment on that. (06 Marks)

OR

- 4 a. Explain different types of clay minerals. (08 Marks)
- b. A proctor compaction test was conducted on a soil sample and the following observations were made:

| W.C. (%) | 8 | 11.5 | 14.5 | 17.5 | 19.5 | 21.5 |
|-----------------------|------|------|------|------|------|------|
| Mass of the soil (kg) | 1.70 | 1.90 | 2.0 | 1.98 | 1.95 | 1.92 |

If the volume of the mould is 950 C.C. and specific gravity of soil was 2.65, draw the:

- (i) Dry density v/s moisture content curve and get the maximum dry density and optimum moisture content.
 (ii) 100% saturation line.
 (iii) Also calculate the minimum void ratio and saturation at OMC. (12 Marks)

Module-3

- 5 a. List the factors affecting permeability in soils. Explain any four. (08 Marks)
- b. An earth dam is built on an impervious foundation with a horizontal filter under the downstream slope. The horizontal and vertical permeabilities of the soil material in the dam are 4×10^{-3} and 1×10^{-3} cm/s respectively. The full reservoir level is 15 m above downstream filter. A flow net, constructed for the transformed section of the dam, consists of 4 flow channels and 15 equipotential drops. Estimate the seepage loss per m length of the dam. (08 Marks)
- c. A stratum of fine sand is 2m thick. Under what head of water, flowing in an upward direction will the quick condition develop? Take $G = 2.68$ and $e = 0.6$. (04 Marks)

OR

- 6 a. Explain Casagrande's method of establishing the phreatic line of an earth dam with horizontal drainage filter on the downstream side. (08 Marks)
- b. Derive the expression for the determination of coefficient of permeability of the soil by falling head method. (06 Marks)
- c. Differentiate between: (i) Total stress (ii) Pore water pressure (iii) Effective stress (06 Marks)

Module-4

- 7 a. Derive the relation $\sigma_1 = \sigma_3 \tan^2 \alpha + 2c \tan \alpha$. (08 Marks)
- b. A shear box test conducted on a soil sample gives the following observations:
- | | | | | |
|--|-----|-----|------|------|
| Normal load (N) | 360 | 720 | 1080 | 1440 |
| Shear load proving ring dial reading (divisions) | 13 | 19 | 26 | 32 |
- If the shear box is 60 mm square and proving ring constant is 20 N per division. Find out the shear parameters (C & ϕ) of the soil in kN/m^2 and degrees respectively. (12 Marks)

OR

- 8 a. Write a note on Vane Shear test. (08 Marks)
- b. The following data relate to a triaxial compressive test performed on a soil samples.
- | Test No. | Confining Pressure (kN/m^2) | Deviatric Stress (kN/m^2) |
|----------|--|--------------------------------------|
| 1 | 80 | 175 |
| 2 | 150 | 240 |
| 3 | 210 | 300 |
- Determine the total stress parameters of the soil. (12 Marks)

Module-5

- 9 a. What is pre-consolidation pressure? How it is determined by Casagrande's method? (08 Marks)
- b. Explain pre-consolidated, normally consolidated and under consolidated soil. (04 Marks)
- c. A 30 cm thick sample of clay reached 30% consolidation in 15 minutes with drainage both at top and bottom. How long will it take the clay layer from which the sample was obtained to reach 50% consolidation? The clay layer has one-way drainage and was 6 m thick. (08 Marks)

OR

- 10 a. Explain the determination of coefficient of consolidation by square root of time fitting method. (08 Marks)
- b. A 3 m thick layer of clay was subjected to a loading of 0.7 kg/cm^2 . It attained 50% consolidation after 1 year. The layer had double drainage. Determine:
 (i) Coefficient of consolidation (ii) Settlement after one year if $k = 5 \text{ mm/yr}$
 (iii) Time required for 90% consolidation (12 Marks)

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