WEST BENGAL UNIVERSITY OF TECHNOLOGY

CE-403

SOIL MECHANICS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable. All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer *all* questions. $10 \times 1 = 10$

(i) If the flow net of a coffer dam foundation had 6 nos. of flow channel and 16 nos. of equipotential drops, with the head of water lost during seepage being 6m through the foundation having $k = 4 \times 10^{-5}$ m / minute, the seepage loss in m^3/ day per meter length of dam will be

(A) 2.16×10^{-3} (B) 6.48×10^{-3}
(C) 12.96×10^{-2} (D) 25.92×10^{-2}

(ii) Which one of the following equation correctly gives the relationship between the specific gravity of soil grains (G) and the hydraulic gradient(i) to initiate quick conditions in a sand having a void ratio of 0.5

(A) $G = 1.5i + 1$ (B) $G = I + 0.5$
(C) $G = 0.5i + 1$ (D) $G = 1.5i - 1$

(iii) If k_x and k_z are the permeabilities in the x- and z- directions respectively, the effective permeability k_e is given by

(A) $k_e = \sqrt{k_x k_y}$ (B) $k_e = k_x + k_y$

(C) $k_e = \frac{k_x}{k_y}$ (D) $k_e = k_x - k_y$

(iv) A flow net is drawn for a weir. The total head loss is 6m, number of potential drop is 10 and the length of flow path of the last square is 1m. The exit gradient is

(A) 0.6 (B) 0.7 (C) 1.0 (D) 1.6

(v) The discharge velocity and void ratio of a stratified deposit are 0.25 cm/sec and 0.5 respectively. The seepage velocity in cm/sec of that deposit is

(A) 0.65 (B) 0.75 (C) 0.85 (D) 0.95

(vi) A soil sample contains inorganic silt and very fine sand or clayey silts with low plasticity. The group symbols of IS classification system is

(A) ML. (B) CL. (C) GW. (D) SP

(vii) In a standard proctor test, 1.8 kg of moist soil was filling the mould (volume = 944cc) after compaction. A soil sample weighing 23g was taken from the mould and oven dried for 24 hours at a temperature of 110 °C. Weight of the dry sample was found to be 20g. Specific gravity of soil solids is, G = 2.7. The theoretical maximum value of the dry unit weight of the soil in kN/m^3 at that water content is equal to

(A) 4.67 (B) 11.5 (C) 16.26 (D) 18.85

(viii) In a compaction test if the compacting effort is increased, it will result in

(A) increase in maximum dry density and OMC

(B) increase in maximum dry density but OMC remains unchanged

(C) increase in maximum dry density and decrease in OMC

(D) no change in maximum dry density but decrease in OMC

(ix) The hydrostatic pressure on the phreatic line within a dam section is

(A) less than atmospheric pressure

(B) equal to atmospheric pressure

(C) greater than atmospheric pressure

(D) none of these

(x) Vertical stress on a vertical line at a constant radial distance from the axis of a vertical load

(A) is same at all depth

(B) increases with depth

(C) first increases, attains a maximum value and then decreases

(D) first decreases, attains a minimum value and then increases

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. $3 \times 5 = 15$

2. In a hydrometer analysis, particles of different sizes were mixed to from a uniform suspension of volume 1000 cm^3. It is required to determine the time required for the fall of all the particles of sizes ranging from 0.05 mm to 0.001 mm and also the time required for the coarsest of the particles to fall. The depth of fall given is 20 cm. the other data available are G = 2.7 and $\mu = 8.1 \times 10^{-3}$ poises.

3. The total unit weight of soil is 18.8 kN/m^3, the specific gravity (G) of the solid particles of the soil is 2.67 and the water content (w) of the soil is 12%. Calculate the dry unit weight, void ratio and degree of saturation.

4. Define the terms 'seepage, seepage pressure, flow nets, flow lines, equipotential lines, hydraulic gradient, flow path, piezometric level'.

5. In an unconfined compression test a sample of clay 100mm long and 50mm in diameter fails under a load of 150N at 10% strain. Calculate the shearing resistance taking in to account the effect of change in cross-section of the sample.

6. What do you understand by 'Optimum moisture content' and 'Maximum dry density'? Explain with a typical compaction curve for a cohesive soil.

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

7. (a) For constructing an embankment, the soil is transported from a borrow area using a truck which can carry 6 m^3 of soil at a time. With the following details, determine the number of truck loads of soil required to obtained 100 m^3 of compacted earthfill and the volume of borrow pit. 10+5

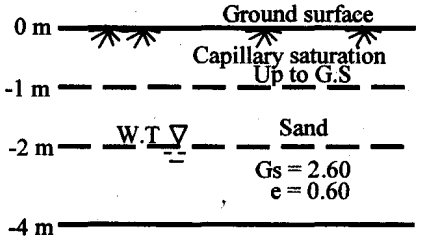
Property	Borrow area	Truck (loose)	Field (compacted)
Bulk Density	16.6 kN/m^3	11.5 kN/m^3	18.2 kN/m^3
Water content (%)	8 %	6 %	14 %

(b) The liquid limit and plastic limit of a given soil sample are 65% and 40% respectively. Compute its consistency index, liquidity index, flow index and toughness index. Given that the water content in the soil sample decreases from 80% to 40% for a ten-fold increase in the number of blows required to close the groove in the standard liquid limit apparatus.

8. (a) How will you find out the co-efficient of permeability 'k' in the field containing unconfined aquifer, show the necessary derivation of 'k' with neat sketches? 8+7
   (b) A pumping test was made in medium sand extending to a depth of 50 ft where a bed of clay was encountered. The normal ground water level was at the ground surface. Observation wells were established at a distances of 10 and 20 ft from the pumping well. A steady state was reached at a pumping rate of 1.2 cubic ft/sec. The drawdown of the outer well was 0.5 ft and the inner well was 1.5 ft. What was the co-efficient of permeability of the sand?

9. A concrete weir with a sheet pile of 6 m depth at the heel rests on a 16m thick sandy stratum. Length of the base is 20m and it has a retain 8 m of water on u/s. The base has been put 2m below ground. The value of K for the soil on which the weir is resting is 4.6×10^{-4} cm/sec and specific gravity of the soil grains is 2.65. 10+2+3
   (a) Draw the flow net and ealculate the amount of water seeping under the weir per meter width.
   (b) Is there any chance of piping failure?
   (c) Calculate the uplift pressuer on the bottom of the weir 10m from the heel.

10. (a) Write a short note on Quick sand condition and Phreatic line. 7+3+5
    (b) Explain the term total stress neutral stress and effective stress.
    (c) For the subsoil conditions shown in figure. What are the effective stress values at 1m, 2m and 4m depths? Assume $\gamma_\omega = 10 kN/m^3$.



(a) Subsoil conditions

11. (a) A footing 1.5m square is located 1.5m below the surface of a uniform soil deposit of density 20 kN/m^3. The void ratio of the soil is 0.8 and its compression index is 0.07. If the total thickness of the deposits, which is underlain by rock strata, is 3.5 m, compute the primary consolidation settlement of the footing when it carries a load of 225 kN. Use trapezoidal stress distribution (2:1 horizontal to vertical) and consider four layers. 10+5

(b) Distinguish between compaction and consolidation.