

B.Tech 6th Semester Exam., 2022

(New Course)

GEOTECHNICAL ENGINEERING—II

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
(ii) There are **NINE** questions in this paper.
(iii) Attempt **FIVE** questions in all.
(iv) Question No. 1 is compulsory.

1. Fill in the blanks (any seven) : $2 \times 7 = 14$

- (a) The empirical relationship established by Skempton between the compression index (C_c) and liquid limit (W_L) is ____.
- (b) When the average degree of consolidation U is less than 60%, the time factor T is given by ____.

(c) The void ratio at which further strain does not produce volume changes is called ____.

(d) In a fully saturated soil, Skempton's pore pressure parameter B becomes equal to ____.

(e) When normal stress is 100 kN/m^2 , the magnitude of shear stress on a principal plane is ____.

(f) ____ is a direct method of soil exploration.

(g) The minimum depth of soil exploration below a footing shall be at least ____ the width of footing.

(h) The factor of safety is defined as the ratio of shear strength to ____ along the surface of failure.

(i) If the Poisson's ratio of a backfill material is 0.5, the theoretical value of coefficient of earth pressure at rest is ____.

- (j) Failure of the bottom of a deep excavation in sand due to the lowering of the water level inside relative to the outside is due to the phenomenon of _____.
2. (a) List the assumptions made in deriving Terzaghi's one-dimensional consolidation theory. Differentiate between primary consolidation and secondary consolidation. 7
- (b) A 3 cm thick laboratory soil sample reaches 55% consolidation in 75 seconds under double-drainage condition. Find how much time will be required for an 8.0 m thick layer in the field to reach the same degree of consolidation if it has drainage face on one side only. 7
3. (a) What are the drained and undrained shear tests? Under what conditions should the drained shear strength or the undrained shear strength parameters be used? Explain. 7

- (b) Keeping the minor principal stress constant as 200 kPa, the major principal stress on a cylindrical soil sample was increased till the failure occurred. If the cohesion and angle of internal friction of the soil were 300 kPa and 22° respectively, calculate—
- (i) the maximum axial stress at failure;
- (ii) the shear and normal stress along the failure plane;
- (iii) the angle of inclination of the failure plane. 7
4. (a) What is meant by an infinite slope? Derive an expression for the factor of safety of an infinite slope in a cohesionless soil. 7
- (b) The soil of a 21° infinite slope is subjected to full depth seepage. The soil properties are $\gamma_{\text{sat}} = 18 \text{ kN/m}^3$, $c' = 11 \text{ kN/m}^2$ and $\phi = 15^\circ$. Determine the limiting depth H , of this soil, measured vertically. 7

5. (a) Explain the 'wash boring' method for drilling boreholes and the use of a 'split spoon sampler' for collecting soil samples from the bore. 7
- (b) A sampling tube has an outer diameter of 70 mm and wall thickness 1.6 mm. Find the area ratio of the tube and comment on the result obtained. 7
6. Discuss with neat sketches any two boring methods used in soil exploration. 14
7. (a) Explain the Swedish circle method for the analysis of stability of finite slopes. 7
- (b) For a railway embankment, 10 m high embankment is required. The clay to be used for the embankment was found to have $c = 20 \text{ kN/m}^2$ and unit weight $= 19 \text{ kN/m}^3$. Compute the critical maximum side slope angle for the embankment if a hard rocky stratum was found 5.0 m below the

ground level. Assume $\phi = 0$. The following values are given from Taylor's chart : 7

For depth factor $D = 1.5$ value of

S_n	0.181	0.174	0.164	0.150
β (Degree)	53	45	30	20

8. (a) What do you understand by the active and passive earth pressure? How will you determine these in cohesive and cohesionless soil? 7
- (b) A cut 2 m wide and 6 m deep is proposed in a dense sand with $\phi = 25^\circ$ and $c = 0$. Sketch the suitable scheme of sheeting and bracing. Also determine the strut load. Assume unit weight of soil is 21 kN/m^3 . 7
9. Write short notes on any four of the following : $3\frac{1}{2} \times 4 = 14$
- (a) Percussion drilling
- (b) Bore-hole log

- (c) Cone penetration test
- (d) Friction circle method and its use
- (e) Critical height of unsupported cuts in clay soils
- (f) Time factor
