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Roll No. of candidate | | | | | | | | | | |

2023

B.Tech. 6th Semester End-Term Examination

Civil Engineering

GEOTECHNICAL ENGINEERING – II

(New Regulations (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19))

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following: (10 × 1 = 10)

(There can be more than one correct option)

(i) The most natural mode of failure that might occur in the case of the retaining wall is

(a) Active earth pressure condition

(b) Passive earth pressure condition

(c) At rest earth pressure condition

(d) All of these options

(ii) To avoid large lateral pressure on retaining wall, proper provision for drainage must be made behind the retaining wall.

(a) True (b) False

(iii) Loss of shear strength in slope is due to

(a) Increase in pore water pressure

(b) Excessive settlements

(c) Compaction

(d) Internal seepage

[Turn over

(iv) The following assumption is invalid for the friction circle method

(a) The resultant passes through the centre of the friction circle

(b) Friction is fully mobilised

(c) The resultant is tangential to the friction circle

(d) Total stress analysis is applicable

(v) IS 2131 (1981) recommends an overburden pressure correction to be applied to the N value obtained from an SPT under some conditions. The main reason to apply this overburden pressure correction is

(a) To neglect the effect of negative pore pressure likely to develop in dense soils

(b) To neglect the overburden effect due to which lower N value is obtained at shallow depth and higher N value is obtained at greater depth

(c) Both (a) and (b)

(d) None of these

(vi) Which type of boring method is most suitable for subsurface exploration below the groundwater table?

(a) Wash boring (b) Rotary drilling

(c) Auger boring (d) None

(vii) A footing on sand with a relative density of less than 20% is likely to fail by

(a) General shear failure (b) Local shear failure

(c) Punching shear failure (d) None

(viii) The bearing capacity of a footing on a clay soil increases with increase in the width of the footing.

(a) True (b) False

(ix) Initial pile load tests should be carried out on test piles or working piles, preferably on test piles.

(a) True (b) False

(x) The grip length of a well foundation is its depth below the normal depth of scour.

(a) True (b) False

2. (a) A retaining wall of 8 m high retains a cohesionless soil with an angle of internal friction 30°. The backfill surface is level with the top of the wall. The unit weight of the top 5 m of the fill is 18 kN/m^3 and that of the rest is 20 kN/m^3. Draw the active earth pressure distribution diagram and determine the magnitude and point of application of the total lateral active earth force per unit length of the wall.

(5+3+2)

(b) An unsupported excavation is to be made in a clay layer. If $\gamma = 20$ kN/m^3, $c = 20$ kN/m^2 and $\phi = 10°$, what is the maximum depth of excavation that can be left unsupported? (5)

3. (a) A square footing 3 m × 3 m is placed at a depth of 2.5 m below the ground surface. The properties of the foundation soil are: (10)

$$c = 25 \text{ kN/m}^2, \phi = 37°, \gamma = 20 \text{ kN/m}^3.$$

For ϕ 37°, $N_c = 55.6$, $Nq = 42.9$, $N_\gamma = 66.2$

The load on the footing is concentric and vertical. Determine by IS 6403 (1981) recommendations, the safe load that can be supported by the footing with a factor of safety of 3 with respect to shear failure.

(b) A purely cohesive soil was tested by unconfined compression. The unconfined compressive strength was obtained as 40 kN/m^2. Determine the ultimate bearing capacity of the soil as per IS: 6403 (1981) guidelines. (5)

4. (a) A group of 9 piles with 3 piles in a row was driven in to a homogeneous clay deposit. The diameter and length of piles were 30 cm and 10 m respectively. The undrained cohesion, Cu of the clay deposit is 40 kN/m^2. If the piles were spaced at 90 cm center to center, compute the safe load on the pile group on the basis of shear failure criteria for a factor of safety of 2.5. Neglect bearing at the tip of piles. (10)

(b) What are the reasons that could lead to the development of negative skin friction in a pile foundation? (5)

5. (a) The outer and inner diameter of the cutting edge of a soil sampler are 51 mm and 48 mm respectively. Determine the area ratio of the sampler and comment on the nature of the stiff and soft soil samples obtained in the sampler. (5)

(b) The field standard penetration test value, N in a deposit of fully submerged fine sand was 35 at a depth of 5 m. The saturated unit weight of the soil is 20 kN/m^3. Calculate the corrected N value as per IS: 2131 (1981) guidelines. (5)

(c) What is meant by the "significant depth" of soil exploration? Give an empirical guideline which enables the determination of the depth of soil exploration. (5)

6. (a) What is Taylor's stability number and how do you use the stability chart? (5)

(b) A granular soil has $\gamma_{sat} = 19$ kN/m^3 and $\phi = 35°$. A slope has to be made of this material. If a factor of safety of 1.3 is needed against slope failure, determine the safe angle of the slope when (i) the slope is dry and (ii) seepage occurs at and parallel to the surface of the slope. (5+5)

7. (a) What considerations govern the fixing of the depth of a well foundation? (3)

(b) The following observations relate to a plate load test conducted on a 30 cm square test plate placed at a depth of 1.5 m in a cohesionless soil deposit: (12)

Intensity of load (kg/cm^2)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Settlement (mm) :	0	2.0	4.0	7.0	11.0	16.0	23.0	32.0	45.0

Determine the settlement of a foundation 2.5 m × 2.5 m carrying a load of 100 ton and located at a depth of 1.5 m below ground surface.