Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(CE)/SEP.SUPPLE/SEM-8/CE-802/1/2012

2012

SOIL STABILIZATION & GROUND IMPROVEMENT TECHNIQUE

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words

as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

   i)   The minimum value of coefficient of permeability of the soil required for the possibility of applying Dewatering for soil improvement technique is

   a) $K_{min} > 10^{-8}$ m/s   b) $K_{min} > 10^{-9}$ m/s

   c) $K_{min} > 10^{-10}$ m/s   d)   none of these.

   ii) Ground freezing system is useful when nature moisture content present in the soil

   a)   below 5%   b)   above 10%

   c)   above 5%   d)   below 10%.

iii) In lime stabilization the optimum percentage of lime added to loam or clay soils is about

    a)   3% to 4% of the dry weight of the soil

    b)   5% to 8% of the dry weight of the soil

    c)   8% to 10% of the dry weight of the soil

    d)   none of these.

iv) The size of the stones to be used in stone columns may vary from about

    a)   6 mm to 40 mm   b)   40 mm to 80 mm

    c)   80 mm to 100 mm   d)   100 mm to 150 mm.

v) The spacing of stone columns may be varying from

    a)   4 mm to 5 mm   b)   3 mm to 4 mm

    c)   1 m to 3 m   d)   5 mm to 6 mm.

vi) A backfill material will be unsuitable in a vibroflotation work when the suitablity number is

    a)   < 20   b)   < 30

    c)   > 30   d)   > 50.

vii) For the economical use of vibratory rollers the minimum number of passes normally required are of

    a)   4 to 6 passes   b)   2 to 3 passes

    c)   8 to 10 passes   d)   10 to 12 passes.

viii) The depth (d in metre) of the compaction can generally be estimated by the empirical expression

a) $d = 2 \cdot 5\sqrt{WH}$

b) $d = 1 \cdot 5\sqrt{WH}$

c) $d = 0 \cdot 5\sqrt{WH}$

d) $d = 3\sqrt{WH}$

where, W is the mass of the pounder in tonnes and H is the height of fall in metres.

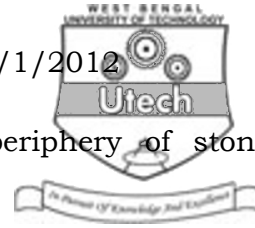ix) The spacing of vertical drain for a triangular pattern is equal to

a) $\dfrac{d_e}{1 \cdot 05}$

b) $\dfrac{d_e}{1 \cdot 128}$

c) $\dfrac{d_e}{1 \cdot 5}$

d) $\dfrac{d_e}{2 \cdot 1}$.

x) Sigma model and Tau model were proposed by

a) Hausmann

b) Henri Vidal

c) NSW Institute of Technology

d) None of these.

xi) The area replacement ratio for triangular pattern may be expressed as

a) $a_s = 0 \cdot 907 \, (D/S)^2$

b) $a_s = 0 \cdot 785 \, (D/S)^2$

c) $a_s = 1 \cdot 5 \, (D/S)^2$

d) $a_s = 2 \, (D/S)^2$.

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[Turn over

xii) Providing the skirting along the periphery of stone columns

    a) increases the load carrying capacity and reduces the settlement

    b) decreases the load carrying capacity and increases the settlement

    c) decreases the load carrying capacity

    d) none of these.

xiii) Stone columns are not applicable to deposits of

    a) highly organic silts or clays

    b) loose sands

    c) inorganic clays

    d) inorganic silts.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. Enumerate the advantages of reinforced earth structures. What materials are used for reinforcing soils ?

3. Discuss in brief the different grouting techniques for the improvement of foundation soil. Also mention their advantages and disadvantages.

4. What is meant by chemical stabilization ? Explain in brief the various admixtures which are used in stabilization of soils.

5. Explain and discuss the various methods that are used for lowering the ground water table during construction, drawing neat sketches.

6. Determine the number of passes required to compact 400 m³ (compacted volume) of earth, with a roller at a speed of 6 km/hr, time of rolling 50 minutes, length of drum 4·0 m, number of drums 2, fraction of overlap $\frac{1}{5}$, and layer thickness 0·5 m.

7. Determine the suitability number of a backfill of which D_{50} = 1·4 mm, D_{20} = 0·65 mm, D_{10} = 0·07 mm.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

8. a) What is meant by 'Soil stabilisation' ? Discuss the basic principle of soil stabilization.

   b) What are stone columns ? Discuss the different methods of installation of stone columns and indicate their relative merits and demerits.

   c) Describe the mechanism of lime soil stabilization.

   5 + 7 + 3

9. A site consisting of a cohesive deposit of depth 8 m extending from 1 m Ground level to 9·0 m followed by a very stiff strata. The undrained cohesion (Cu) is 18 kN/m². A stone column system of dia 400 m and of length 9 m with centre to centre spacing of 1·1 m is intalled in the site. The water table is at a depth of 1·0 m from the G.L. The average unit weight of soil (γ_{sat}) is 18 kN/m³. Assume $\varphi_c = 42°$ and $k_0 = 0·6$.

   a) Determine the safe bearing pressure of the soil.

   b) Determine load carrying capacity of the stone column with its tributary soil.

c) Determine the number of stone columns required for a column carrying load of 750 kN and also find out foundation size required.

d) Determine the settlement of the stone column systems.

$$2 + 5 + 4 + 4$$

10. a) Discuss with suitable illustrations the field situations where use of Dynamic consolidation may be economical as a method of ground improvement. Explain briefly the constructional procedure of Dynamic consolidation.

b) Determine the effect of compaction in sandy soils if the tamping weight is 25 tonnes and the drop height is 12 m. $\qquad$ $11 + 4$

11. During construction of a structure, the average permanent load on the clay layer is expected to increase by about 95 kN/m^2. The average effective overburden pressure at the middle of the clay layer is 210 kN/m^2. Thickness of the clay layer is 7m, C_c = 0·27, e_0 = 0·8, C_v = 0·31 m^2/month. The clay is normally consolidated. The clay deposit is underlained and overlained by sandy strata. Determine

a) The total primary consolidation settlement of the strata without pre-compression.

b) The surcharge, ΔP_F , needed to eliminate by pre-loading the entire primary consolidation settlement in 7 months.

c) Determine the time required to eliminate entire primary consolidation settlement for a surcharge of 250 kN/m^2.

12. a) What are vertical drains ? Where are they used ? Discuss briefly different types of Vertical drains.

b) What are the major functions of Geotextiles ? Explain each function giving examples of their uses in railways and water resources projects. 8 + 7

13. a) In a zoned embankment, non-woven Geotextiles are provided to act as a filter between the shell and the core. The seepage estimated using flow nets is $15 \times 10^7 \, m^2/sec\text{-}m$. The Geotextiles is a 8 mm thick, 1500 gsm geosynthetic with an allowable permittivity of $0 \cdot 04 \, sec^{-1}$ and O_{95} of $0 \cdot 03$ mm. The soil of the core is clayey silt with D_{85} of $0 \cdot 04$ mm and k of 6×10^{-8} m/sec. Comment about the suitability of geosynthetic to be used as a filter.

b) Discuss various factors for selection of Ground Improvement Methods. 8 + 7

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