Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech (CE-NEW)/SEM-8/CE-802/1/2011

2011

SOIL STABILIZATION AND 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 × 1 = 10

    i)   The type of grouting having most diverse applications in soils is

         a)   Permeation Grouting

         b)   Displacement Grouting

         c)   Jet Grouting

         d)   Soil fracture Grouting.

    ii) Cement Grout is a/an

         a)   Solution   b)   Emulsion

         c)   Suspension   d)   None of these.
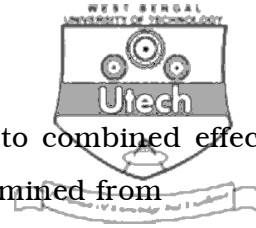
iii) Average degree of consolidation due to combined effect of vertical and radial flow, U_t is determined from

a) $(1 - U_t) = (1 - U_r)(1 - U)$

b) $(1 - U_r) = (1 - U_t)(1 - U)$

c) $(1 - U) = (1 - U_t)(1 - U_r)$

d) None of these.

iv) Stone columns in soft clay derive their strength (axial capacity) on account of

a) Passive resistance of clay against bulging

b) Active resistance of clay against bulging

c) Cohesion of soil

d) Friction of stone materials.

v) Pre-loading using sand rains are most suitable for

a) loose sand

b) soft clay

c) any type of soil

d) coarse sand with low relative density.

vi) Coefficient of consolidation in radial consolidation has a unit of

a) m^2/sec b) m^2/kg

c) m/sec d) m^2/sec^2 .
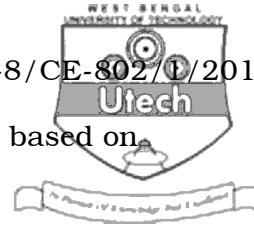
vii) Mehra's method of soil stabilization is based on

    a)   soil and cement

    b)   soil and lime

    c)   brick aggregate and soil

    d)   any one of these.

viii) The stability of mechanically stabilized soil mixes depends upon

    a)   gradation

    b)   properties of soil

    c)   mechanical strength of aggregates

    d)   none of these.

ix) Proportioning of stabilization may be done by

    a)   triangular chart method

    b)   Rothfuch's method

    c)   index properties method

    d)   any one of these.

x) Soil nails are installed to the horizontal near the ground surface at the inclination of

    a) $10°$ to $15°$ b) $12°$ to $15°$

    c) $20°$ to $25°$ d)   none of these.

xi) Vibratory rollers are efficient in compacting

    a)   sandy soil

    b)   both sandy and clayey soils

    c)   clayey soil

    d)   silty and clayey soils.

xii) Hydrated lime $\left[Ca(OH)_2\right]$ can be effectively used for stabilization of

    a)   plastic clayey soil   b)   sandy soil

    c)   silty soil   d)   none of these.

xiii) Bond stress between grout and rock $\left(Lb/in^2\right)$ for sand stone is

    a)   120 – 250   b)   120 – 200

    c)   150 – 220   d)   30 – 120.

GROUP – B

(Short Answer Type Questions)

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

2.   Briefly describe the use of Geotextile in erosion control.

3.   Write a short note on Lime stabilization process.

4.   Briefly describe the methods of grouting.

5.   What are the relative merits and demerits of soil densification by compaction piles ?

6.   What is Dewatering ? Discuss briefly.

7.   "Vibroflotation in clays – Not an in-situ densification process." Explain the statement.

8.   Why are grouting techniques not successful in rectifying tilted structures resting on soft saturated clay ?

GROUP – C

(**Long Answer Type Questions**)

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

9. a) Write down the equation of consolidation for combined effect of vertical and radial flows.

b) Compute the average degree of consolidation of a soft clay layer after 8 months of application of surcharge for the following cases :

i) No sand drains

ii) Sand drains of dia 250 mm at a spacing of 2·20 m arranged in square grid.

Given : Thickness of soft clay = 12 m, double drainage case.

$C_{Vz} = 0 \cdot 5 \text{ m}^2/\text{year}$, $C_{Vr} = 1 \cdot 5 \text{ m}^2/\text{year}$,

Surcharge = $80 \text{ kN}/\text{m}^2$, $C_c = 0 \cdot 75$.

$U_r\%$	T_r		
	$R/r_0 = 5$	$R/r_0 = 10$	$R/r_0 = 20$
10	0·012	0·021	0·030
30	0·042	0·070	0·101
60	0·107	0·180	0·258
90	0·270	0·455	0·649

10. Explain with neat sketches how geosynthetics find their use in geotechnical engineering to serve as separators, filters, drains, reinforcement, hydraulic barriers, protectors and erosion control system.
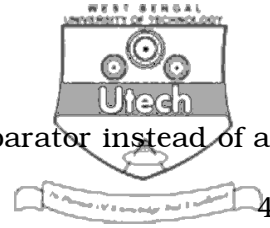
11. a) Can one use a geomembrane as a separator instead of a geotextile beneath a road ? 4

   b) A geotextile of thickness 1·0 mm and mass per unit area of 500 gsm is recommended for use at a site. It is not available in the local and nearby markets. Instead a lower grade material of the same type but having a thickness of 0·5 mm and mass per unit area of 250 gsm is available. Can one use two layers of the latter type of geosynthetic, placed one above the other as a substitute for the recommended geotextile ? 4

   c) In which of the following cases will the soil to geosynthetic interface shearing resistance be the maximum and in which case the least for the same set of site condition ? Why ?

   i) Geomembrane embedded in soil

   ii) Geotextile embedded in soil

   iii) Geogrid embedded in soil. 7

12. a) What is the meaning of soil stabilization ? 2

   b) How is soil stabilized by using soft aggregates ? 5

c) It is proposed to construct a sandy clay road conforming to the following gradation specification :

IS Sieve	% Gradation Limit	Sand material (A)	Silt-clay material (B)
4·75 mm	100	100	—
2·36 mm	80 – 100	91	—
1·18 mm	50 – 80	34	100
425 μ	30 – 60	9	85
300 μ	20 – 45	3	59
75 μ	10 – 25	2	36

Gradation requirements indicate that a ratio 1 : 1 of the two materials would be adequate. *L L* & *P I* of the materials *A* and *B* are as under :

|	A	B
LL	20%	35%
PI	2%	10%

What will be the *LL* & *PI* of the mixture ? If the maximum *LL* & *PI* are to be respectively 35% & 9%, what should be the proportion of *A* & *B* in the mix ?   8

13. a) For the reinforced earth wall shown in figure on page 8 find

   i) The length L_e of the strip reinforcement S_{10} such that the reinforcement will not slip out of the stable zone and

ii) The thickness, t of the strip such that it will not rupture. Given that the yield stress in stress in steel = 250000 kN/m^2, tan δ = 0·7 tan Φ, horizontal and vertical spacing of strips = 1 m and the width of strip, b = 0·1 m
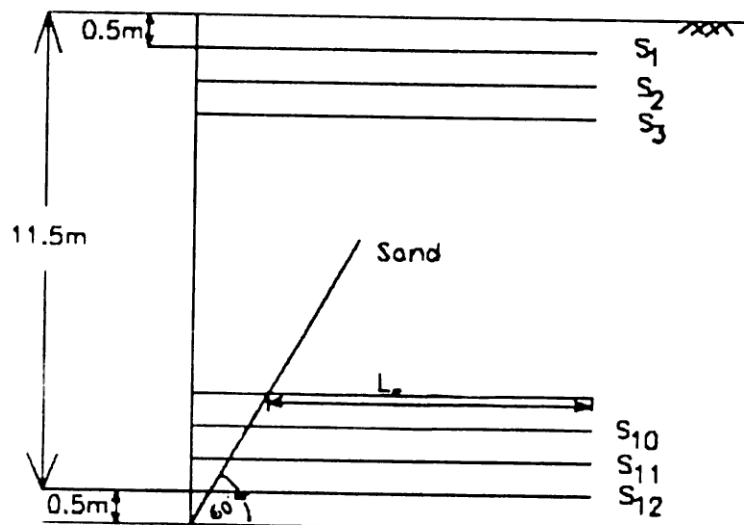
b) What is the application of soil reinforcement ?

14. Describe the densification of *in situ* granular soils by impact at ground surface. Determine the effect of compaction in sandy soils if the tamping weight is 20 tonnes and the drop height is 10 m. How is improvement of loose sand determined in impact compaction ?   10 + 5

15. Describe the various parts of Anchor system. The *in situ* void ratio of a granular soil deposit is 0·50. The maximum and minimum void ratios of the soil were determined to be 0·75 and 0·35, $G_s = 2·67$. Determine the relative density and relative compaction of the deposit.   5 + 10