*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/B.Tech/CE/OLD/SEM-6/CE-601/2013**

**2013**

# SOIL MECHANICS-II

*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) In the light compaction test, the number of blows used per layer is

a) 15 b) 25

c) 30 d) 35.

ii) The use of sheep's foot rollers to compact cohesion-less soils in

a) very effective b) moderately effective

c) effective d) ineffective.

iii) When consolidation of saturated soil sample takes place, the degree of saturation

a) decreases

b) increases

c) remains constant

d) decreases initially and then increases.

iv) Which soil parameter is considered as a measure of the degree of over-consolidation ?

a) Pre-consolidation pressure

b) Compression index

c) over-consolidation ratio

d) coefficienct of consolidation.

v) The liquid limit of a saturated normally consolidated soil is 50%. The compression index of the soil for the virgin compression curve will be

a) 0.36 b) 0.505

c) 0.605 d) 0.705.

vi) The unconfined compression test is a special type of

a) vane shear test

b) unconsolidated-undrained triaxial test

c) unconsolidated-undrained direct shear test

d) drained triaxial test.

vii) Identify the incorrect statement. Effective stress shear parameter of a clay can be obtained from

a) Drained triaxial shear test

b) Drained direct shear test

c) Consolidated-undrained traixial shear test with pore water pressure measurements

d) Unconsolidated-undrained triaxial shear test with pore water pressure measurements.

viii) When a saturated soil mass is loaded under undrained condition, the load according to Terzaghi's concept is

a) Borne entirely by water

b) Borne entirely by soil solids

c) Shared equally by soil solid

d) Shared between soil solids and water proportional to their volumes.

ix) The lateral earth pressure coefficients Ka and Kp refer to

a) effective stresses

b) total stresses

c) neutral stresses

d) none of these.

x) A sandy loam backfill has cohesion of 14 $kN/m^2$, a friction angle of 18° and unit weight of 16.5 $kN/m^3$. Then, the depth of tension crack is

a) 2.00 m b) 3.33 m

c) 1.98 m d) 2.63 m.

xi) If for an inclined backfill, with the angle of backfill inclination $i$ and angle of shearing resistance $\varphi$ are equal, then for the Rankine condition the active earth pressure coefficient is

a) $\cos^2 i$ b) $\sin^2 i$

c) $\cos i$ d) $\sin i$ .

xii) A base failure is likely to occur

a) $\varphi_u > 0^\circ$ and $\beta < 53^\circ$

b) $\varphi_u = 0^\circ$ and $\beta > 53^\circ$

c) $\varphi_u = 0^\circ$ and $\beta < 53^\circ$

d) $\varphi_u > 0^\circ$ and $\beta > 53^\circ$ .

xiii) Bishop's simplified method of slices satisfies

a) all the statical equilibrium condition

b) only the vertical force equilibrium condition

c) only the moment equilibrium condition

d) all the conditions except the horizontal force equilibrium condition.

xiv) Identify the incorrect statement. A sheet pile wall may fail in any one of the following ways

a) forward movement of the base

b) failure by bending

c) failure by shear

d) failure of anchors.

## GROUP – B
## ( Short Answer Type Questions )

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

2. Define OMC and state on what factors it depends. Write a note on field compaction control. 3 + 2

3. Briefly explain the physical meaning of the co-efficient of consolidation. Explain 'Secondary consolidation'. 3 + 2

4. Write notes on Compaction and Consolidation. What is the difference between these two ? 2 + 3

5. What is shear strength ? What is over-consolidated clay ? What is cell pressure and deviator stress ? 1 + 2 + 1 + 1

6. What is cofferdam ? Discuss on different types of cofferdam. 1 + 4

7. What is sheet pile ? What is its utility ? Draw the earth pressure diagram for a cantilever sheet pile in cohesive soil. 1 + 1 + 3

8. What is earth pressure at rest ? Derive the equation for determining the magnitude of earth pressure for rest backfill. 1 + 4

9. Give a critical comparison of the Coulomb and Rankine earth pressure theories.

**GROUP – C**
**( Long Answer Type Questions )**
Answer any *three* of the following. 3 × 15 = 45

10. a) The following data refers to a compaction test as per Indian Standard ( light compaction ) :

| | | | | | | |
|---|---|---|---|---|---|---|
| Water content (%) | 8·5 | 12·2 | 13·75 | 15·5 | 18·2 | 20·2 |
| Wt. of wet sample (kg) | 1·80 | 1·94 | 2·00 | 2·05 | 2·03 | 1·98 |

If the specific gravity of soil grains was 2.7,

i) plot the compaction curve and obtain the maximum dry unit weight and the optimum moisture content

ii) plot the 80% and 100% saturation lines

iii) if it is proposed to secure a relative compaction of 95% in the field, what is the range of water content that can be allowed ? 9

b) It is required to construct an embankment by compacting a soil excavated from nearby borrow areas. The optimum moisture content and corresponding $\gamma_d$ in laboratory is 20.8% and 1.71 gm/cc respectively. However, the natural moisture content and $\gamma_b$ in field are 8.3% and 1.84 gm/cc respectively. Find out the quantity of soil to be excavated and the quantity of water to be added to it, for 125 $m^3$ of finished embankment. 6

11. a) A clay layer whose settlement under a given loading is expected to be 16 cm settles 4 cm at the end of 2 months. How many months will be required to reach a settlement of 8 cm ? How much settlement will occur in 10 months ? 6

b) The soil profile at a building site consists of sense sand upto 3m depth, normally loaded soft clay from 3 m to 7 m depth and stiff impervious rock below 7m depth. The ground-water table is at 0.40 m depth below ground level. The sand has a density of 18 $kN/m^3$ above water table and 19 $kN/m^3$ below it. For the clay, natural water content is 52%, liquid limit is 66% and specific gravity is 2.65. Calculate the probable ultimate settlement resulting from a uniformly distributed surface load of 42 $kN/m^3$ applied over an extensive area of the site. 6

c) In a laboratory consolidation test with porous discs on either side of the soil sample, the 25 mm thick sample took 84 minutes for 90% primary compression. Calculate the value of coefficient of consolidation for the sample. 3

12. a) What is stability number ? Discuss on different types of failure in finite slope. 2 + 4

b) An embankment is made of soil having $c' = 10$ kN/m$^2$; $\varphi' = 23^\circ$ and $\gamma = 19$ kN/m$^3$. The embankment is of 9m height and has a slope of 30°. The average pore pressure ratio may be taken as 0·30 for the condition of steady seepage. Using the Fellenius method of slices, determine the factor of safety against shear failure, for a slip circle passing through the toe. Locate the centre of rotation by the Fellenius method. 9

13. a) What are the principal planes and principal stresses ? What is Mohr failure envelope ? 4 + 2

b) A sample of dry coarse sand is tested in the laboratory triaxial apparatus in the undrained condition. Under a cell pressure of 2.5 kg/ cm$^2$, the sample failed when the deviator stress reached 5.23 kg/cm$^2$.

i) Determine the shear parameters of the soil

ii) At what deviator stress will the soil fail if the cell pressure be 3.2 kg/cm$^2$ ? 9

14. a) A CU test was conducted on a normally consolidated clay for which it can be assumed that $C' = C_u = 0$. A sample failed at a deviator stress of 50 kN/m$^2$, when the cell pressure was 100 kN/m$^2$. What is the value of $\varphi_u$ ? If $\varphi' = 32^\circ$ for the soil, what was the pore water pressure at failure ? 6

b) The results of a direct shear test performed on a soil sample in a shear box of 6 cm × 6 cm size are given below :

| Normal Load (Kg) | 30 | 40 | 50 | 60 |
|---|---|---|---|---|
| Shear force at failure (Kg) | 18.1 | 25.8 | 33.1 | 39.8 |

Plot the failure envelope for the soil and determine its shear parameters. 9

15. a) A retaining wall 7m high, with a smooth vertical back is pushed against at soil mass having $C' = 40$ kN/m$^2$; $\varphi' = 15^\circ$ and $\gamma = 19$ kN/m$^3$. What is the total Rankine's passive pressure, it the horizonatal soil surface carries a uniform load of 45 kN/m$^2$ ? What is the point of application of the resultant thrust ? 8

b) A retaining wall with a smooth vertical back is 8m high and retains a two layer sand backfill with the following properties :

0 – 5m depth : $c' = 0$, $\varphi' = 30^\circ$, $\gamma = 18$ kN/m$^3$

below 5m : $c' = 0$, $\varphi' = 32^\circ$, $\gamma = 19$ kN/m$^3$

Show the active earth pressure distribution, assuming that the water table is well below the base of the wall. 7