3rd Semester Regular Examination 2016-17
GEOTECHNICAL ENGINEERING
BRANCH: CIVIL
Time: 3 Hours
Max Marks: 100
Q.CODE: Y697
Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1   **Answer the following questions:**   **(2 x 10)**

a) A soil sample has a void ratio of 0.5 and its porosity will be closed to;
   (a) 50%   (b) 66 %   (c) 100%   (d) 33%

b) The void ratios at the densest, loosest and natural states of a sand deposit are 0.2, 0.6, and 0.4 respectively. The relative density of deposit is;
   (a) 100%   (b) 75%   (c) 50%   (d) 25%

c) Consistency as applied to cohesive soil is an indicator of;
   (a) Density   (b) Porosity   (c) Moisture content   (d) Shear strength

d) Vane shear test is normally used for determining in situ shear strength of
   (a) soft clays   (b) stiff clays   (c) Gravel   (d) sand

e) For an anisotropic soil, permeabilities in X and Y direction are K_x and K_y respectively in 2-Dimensional flow. The effective permeabilities K_{eff} for the soil is given by;
   (a) K_x+K_y (b) K_x/ K_y c) $(K_x^2 + K_y^2)^{1/2}$ (d) $(K_x K_y)^{1/2}$

f) Given that C_c =1.4, D_{30}= 3 mm, D_{60} =0.6 mm. Based on this information of particle size distribution for use as subgrade, the soil will be taken as;
   (a) uniformly graded sand   (b) well graded sand
   (c) very fine sand   (d) poorly graded sand

g) The predominant mineral responsible for shrinkage and swelling in black cotton soils is
   (a) Illite   (b) Kaolinite   (c) Mica   (d) Montmorillonite

h) A dry sand specimen is put through a triaxial test. The cell pressure is 50 kPa and the deviator stress at failure is 100 kPa, the angle of internal friction will be;
   (a) 15^0 b) 30^0 c) 37^0 d) 45^0

i) In a consolidation test void ratio decreased from 0.8 to 0.7 when the load was changed from 40 kN/m^2 to 8 kN/m^2. What is the value of compression index?
   (a) 0.14   (b) 0.16   (c) 0.33   (d) 0.66

j) A stratified soil deposit has three layers of thickness; Z_1=4, Z_2=1, Z_3=2 units and corresponding permeabilites are K_1=2, K_2=1, K_3= 4 units respectively. The average permeability perpendicular to bedding plane is;
   (a) 4   (b) 2   (c) 8   (d) 16

Q2   **Answer the following questions:**   **(2 x 10)**

a) What is liquid limit and liquidity index?

b) A sand deposit has a porosity of 1/3 and specific gravity is 2.5. What is the critical hydraulic gradient to cause the quick sand condition?

c) Write down the assumptions for Boussinesq's equation.

d) A soil deposit has a void ratio 0.9. If the void ratio is reduced to 0.6 by compaction, find percentage of volume loss due to compaction.

e) What is Isobar and Pressure bulb?

f) A soil has a bulk density of 18 KN/m^3 at a water content of 5%. If the void ratio remains constant, then what will be the bulk density for a water content of 10%?

g) Explain various types of slope failure.

h) What is sensitivity of clays?

i) What is Zero Air Void Density and how zero air void line is drawn?

j) What is the effect of pore pressure on shear strength of soil? Discuss it.

<u>**Part – B (Answer any four questions)**</u>

Q3 a) In its natural condition a soil sample has a mass of 1.980 kg and volume of 0.001 m^3. After being completely dried in an oven; the mass of the sample is 1.80 kg and specific gravity is 2.7. Unit weight of water is 10 kN/m^3. What is the degree of saturation?   **(10)**

b) What is plastic limit and how it is determined in laboratory?   **(5)**

Q4 a) A layer of saturated clay 5 m thick is overlain by sand 4 m deep. The water table is 3 m below the top surface. The saturated unit weight of clay and sand are 18 kN/m^3 and 20 kN/m^3 respectively. Above the water table, the unit weight of sand is 17 kN/m^3. Calculate the effective stress on a horizontal plane at a depth of 9 m below the ground surface. What will be the increase in effective stress at 9 m if the soil gets saturated by capillary up to a height of 1 m above the water table?   **(10)**

b) Explain the term OMC. How is it affected by compacting effort?   **(5)**

Q5 a) Discuss about the sieve analysis and grain size distribution curve. Explain 'poorly graded', 'gap graded' and 'well graded soil' with sketch. How C_u and C_c are calculated and what is their significance?   **(10)**

b) Laboratory sieve analysis was carried out on a soil sample using a complete set of standard IS sieves. Out of 500 g of soil used in the test, 200 g was retained on IS 600μ sieve, 250 g was retained on IS 500μ sieve, and remaining 50 g was retained on IS 425μ sieve. What is value of coefficient of uniformity of soil? And also comment what type of soil is?   **(5)**

Q6 a) Derive Terzaghi's equation for one dimensional consolidation.   **(10)**

b) Under certain loading a layer of clay is expected to undergo full settlement of 18 cm, also it is expected to settle by 5 cm in the period of first 2 months of loading. Find the time required for the clay layer to settle by 10 cm.   **(5)**

Q7 **a)** Laboratory results on a soil have shown that its unconfined compressive **(10)**
strength is 1.2 kg/cm^2. In a triaxial compression test a specimen of the
soil when subjected to a chamber pressure of 0.4 kg/cm^2 failed at an
additional stress of 1.6 kg/cm^2. Estimate the shearing strength of the
same soil along a horizontal plane at a depth of 4 m in a deposit. The
ground water table is at a depth of 2.5 m from the ground level. Take dry
unit weight of soil as 1.7 gm/cc and specific gravity as 2.7.

b) Discuss Mohr Coulomb failure theory. **(5)**

Q8 **a)** The subsoil profile and its properties at a proposed site of construction is **(10)**
shown below in Figure 1 and Table 1. A square footing 2 m x 2 m carries
a total load of 1000 kN and is laid with its base at 1 m depth below
ground surface. Assuming that post construction settlement in sand is
negligible; determine the consolidation settlement of the clay layer on
account of the construction. The clay is normally consolidated. Use
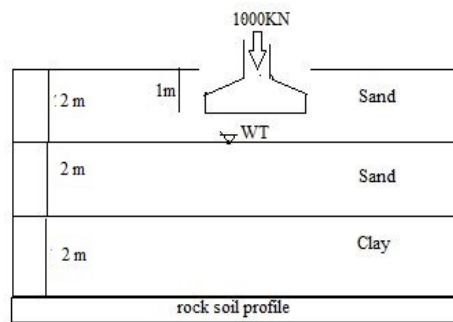approximate 2 to 1 load spread to estimate the stress increase in the clay
layer.

Figure 1

Table 1

Soil properties		
Sand (1st layer)	Sand (2nd layer)	Clay (3rd layer)
Thickness =2 m	Thickness =2 m	Thickness = 2 m
Γ = 16 KN/m^3	Γ = 20KN/m^3	Γ = 19KN/m^3
		w_n = 40%, G_s = 2.7, w_L = 60%

b) Discuss the construction and uses of Newmark's Influence chart. **(5)**

Q9 **a)** Derive the factor of safety for an infinite slope in case of cohesionless soil **(10)**
for the following conditions;
a) When there is no seepage water.
b) When seepage taking place and water table is assumed to be parallel
to slope at a height h above the failure plane.
Assume proper symbols of parameter.

b) What is flow net? What are the properties and uses of flow net? **(5)**