

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2018

Subject Code:2154003

Date:27/11/2018

Subject Name:Geotechnical Engineering - I

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

MARKS

- Q.1 (a)** A given cohesion less soil has $e_{\max} = 0.85$, $e_{\min} = 0.5$. In the field, the soil is compacted to a mass density of 1800 kg/m^3 at water content of 8%. Take the mass density of water as 1000 kg/m^3 and $G_s = 2.7$. What is the value of relative density, R_D ? **03**
- (b)** Derive the relationship of determining water content by Pycnometer method? (Draw a neat sketch) **04**
- (c)** Prove the following using soil 3 phase diagram representation. (Any 3) **07**

$$(1) w = \frac{Se}{G_s}$$

$$(2) \gamma = \frac{(G_s + Se)\gamma_w}{1 + e}$$

$$(3) \gamma_d = \frac{G_s \gamma_w}{(1 + e)}$$

$$(4) \gamma_d = (1 - n)G_s \gamma_w$$

- Q.2 (a)** As per the Indian Standard soil classification system, a sample of silty clay with liquid limit of 75% and plasticity index of 45% is classified as? (Refer to Figure 1) **03**
- (b)** The results of sieve analysis of a soil are given below: **04**
Total Wt.: 500 gm

IS sieve (mm)	4.75	2.36	1.18	0.6	0.3	0.15	0.075
Mass Retained (gm)	0.08	0.81	1.67	2.15	9.09	132.45	310.3

Draw Particle Size Distribution curve on graph.

- (c)** By referring to Question 2 (b) above Calculate percentage of gravel, coarse sand, Medium sand, fine sand, and fines (clay and silt). And Classify the soil. **07**

OR

- (c)** Explain the procedure of estimation of pre-consolidation stress using Casagrande's graphical method? **07**
- Q.3 (a)** Draw a neat sketch for the consistency limits as proposed by Atterberg? **03**
- (b)** A soil sample brought from the field was noted to have a volume of 40 cc weight of 63 g. On oven drying, the weight of the sample was reduced to 55 g. The weight of the dry soil pat with paraffin wax coating was 60 g. The volume of spilled out water due to immersion of pat was 40 cc. Calculate the shrinkage limit and the specific gravity of solids? [Specific Gravity of Wax = 0.83] **04**

- (c) Liquid limit of Soil A is 38%, Soil B is 60% and Plastic limit of soil A is 25% and plastic limit is 30% then, 07
- Which soil will be a better foundation material upon remoulding?
 - Which soil is more compressible?
 - Which Soil shows a higher rate of loss in shear strength upon increase in water content?

OR

- Q.3 (a)** The compaction of an embankment is carried out in 300 mm thick lifts (layers). The rammer used for compaction has the foot of area 0.05 m^2 . The energy developed per drop of the rammer is 40 kg-m. Assuming 50 percent more energy in each pass over the compacted area due to overlap, calculate the number of passes to develop compactive energy equivalent to IS heavy compaction for each layer ? 03
- (b)** Compare the compactive energy used in the IS heavy compaction test with that of the IS light compaction test. 04
- (c)** Following data refers to a compaction test as per IS light Compaction. 07

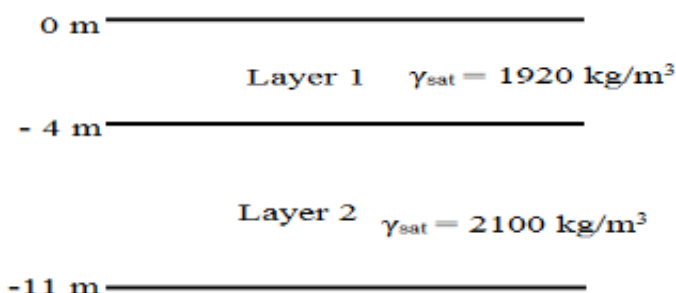
Water Content (%)	8.57	12.24	14.02	16.09	17.29	19.87
Wt. of wet sample (kg)	1.82	1.87	1.99	2.08	1.99	1.90

If the specific gravity of soil grains was 2.7, Plot the compaction curve and obtain MDD and OMC with necessary detailed calculation.

- Q.4 (a)** What is the permeability of soil? How to determine permeability in laboratory? What is the unit of Coefficient of permeability? 03
- (b)** In a falling head permeability test on a sample 12.2 cm high and 44.44 cm^2 in cross sectional area, the water level in a standpipe of 6.25 mm internal diameter dropped from a height of 80 cm to 24.7 cm in 10 minutes. Find the coefficient of permeability. 04
- (c)** Explain Casagrande's Liquid limit determination method to determine Liquid limit of Soil with neat sketch. 07
- How you will find out liquid limit based on the test give suitable example with graphical representation.

OR

- Q.4 (a)** What is consolidation? 03
- (b)** For the soil deposit shown below, draw the total stress pore water pressure and effective stress diagrams. The water table is at ground level as shown in the Figure below. 04



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

Water Content (%)	8.50	12.20	13.75	15.50	18.20	20.20
Weight of wet sample (kg)	1.80	1.94	2.00	2.05	2.03	1.98

If the specific gravity of soil grains was 2.65,

- Plot the compaction curve and obtain the maximum dry unit weight and the optimum moisture content;
- Plot the 80% and 100 percent saturation lines;
- 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

Would the 20 percent air voids curve be the same as the 80 percent saturation curve?

- Q.5 (a)** A specimen of sand from the subgrade of a road failed under following set of conditions. **03**

	σ_3 (kg/cm ²)	σ_1 (kg/cm ²)
A	0.5	1.5
B	1.0	3.0
C	2.0	5.9

Find its friction angle?

- (b) Referring to Q 5 (a) above when the subgrade was stabilized with cement and the test was repeated. The results were: **04**

	σ_3 (kg/cm ²)	σ_1 (kg/cm ²)
A	0.5	2.2
B	1.0	3.9
C	2.0	7.0

Find the gain in the cohesion and also find the gain in the friction angle?

- (c) Explain the laboratory measurement of permeability for both constant Head flow method and falling head flow method. Derive the relationship of coefficient of permeability for both constant head flow method and falling head flow method? **07**

OR

- Q.5 (a)** When an undrained Tri-axial compression test was conducted on specimens of clayey silt, the following results were obtained. **03**

Specimen No.	1	2	3
σ_3 (kN/m ²)	17	44	56
σ_1 (kN/m ²)	157	204	225
u (kN/m ²)	12	20	22

Draw Stress Diagram for that by Mohr circle method.

- Referring to Q5 (a) above Determine the shear parameters considering (i) Total stresses and (ii) effective stresses using Mohr-Coulomb failure criterion? **04**
- Derive Terzaghi's one dimensional consolidation equation for computing the rate of consolidation? **07**

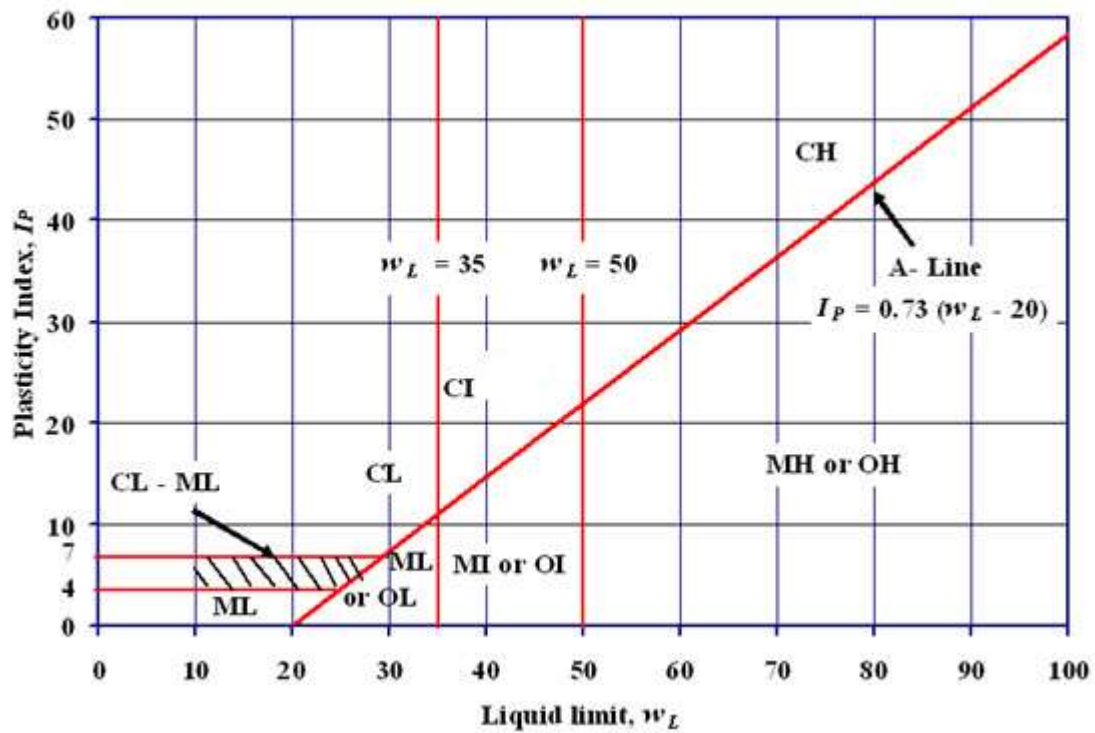


Figure 1: Plasticity chart as per Indian Standard Soil Classification System
