Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2154003 **Date: 06/06/2019**

Subject Name:Geotechnical Engineering - I

Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Semi-log papers & Arithmetic graph papers can be requested from the invigilator.**

MARKS

Q.1 **(a)** What are the Scope and limitation of geo-technical engineering in civil engineering? **03**

(b) Explain Saturated and Dry state of soil by using phase diagram system. **04**

(c) Derive: $S = \frac{w}{\frac{\gamma_w}{\gamma_t}(1+w)-\frac{1}{G_s}}$ **07**

Q.2 **(a)** The results of sieve analysis of a soil are given below: **03**
Total Wt.: 500 gm

IS sieve (mm)	4.75	2.36	1.18	0.6	0.3	0.15	0.075
Mass Retained (gm)	13.1	4.64	2.26	1.08	1.95	364.54	107.8

Draw Particle Size Distribution curve on graph.

(b) By referring to Question 2 (a) above Determine uniformity coefficient and coefficient of curvature. **04**

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

OR

(c) Derive the relationship of determining water content by Pycnometer method? (Draw a neat sketch) **07**

Q.3 **(a)** A sampler with a volume of 45 cm^3 is filled with a non-cohesive dry soil sample. When the soil is poured into a graduated cylinder, it displaces 25 cm^3 of water. What is the porosity and void ratio of the soil? **03**

(b) Define Consistency Limits as per Atterberg with necessary sketch. **04**

(c) In a proctor compaction test, the soil specimen of one of the observation had a bulk density of 19 kN/m^3 with a moisture content of 15%.G_s = 2.7.Determine, **07**

1. Degree of Saturation of the specimen
2. Additional moisture content required for saturating the soil specimen.

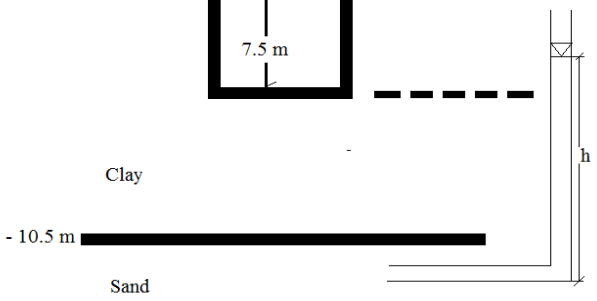
OR

Q.3	**(a)**	Derive, $n = \frac{e}{1+e}$	**03**
	(b)	During a hydrometer analysis a soil with a G_s=2.7 Is immersed in a water suspension with temperature of 24°C, An R=41 cm is obtained after 60 minutes of sedimentation. What is the diameter of D of the smallest-size particles that have the settled during that time? For an ASTM 152 H hydrometer, the value of L for any reading R (corrected for meniscus) may be obtained from L=16.3-0.1641R. Refer to constant K vs T table given in Appendix	**04**
	(c)	What are the factors affecting compaction? Explain it precisely? Explain OMC and Zero Air Void Density? Write the relationship of dry unit weight in terms of water content and Degree of Saturation?	**07**
Q.4	**(a)**	What is consolidation?	**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)	Derive Terzaghi's one dimensional consolidation equation for computing the rate of consolidation?	**07**

OR

Q.4	**(a)**	What are the assumptions made in the derivation of Terzaghi's 1D Consolidation Equation?	**03**
	(b)	During a consolidation test, a sample of fully saturated clay 3 cm thick is consolidated under a pressure increment of 200 kN/m^2. When equilibrium is reached, the sample thickness is reduced to 2.60 cm. The pressure is then removed and the sample is allowed to expand and absorb water. The final thickness is observed as 2.8 cm and the final moisture content is determined as 24%. If the specific gravity of the soil solids is 2.70, find the voids ratio of the sample before and after consolidation?	**04**
	(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**
Q.5	**(a)**	Explain Mohr Circle of stresses?	**03**
	(b)	An excavation was made in a clay stratum having $\gamma_t = 2$ T/m^3. When the depth was 7.5m, the bottom of the excavation cracked and the pit was filled by a mixture of sand and water.	**04**

The thickness of the clay layer was 10.5 m, and below it was a layer of pervious water-bearing sand (Refer Figure). How much was the artesian pressure in the sand layer?



(c) Results of consolidated undrained strength from $\overline{CU}$ tests conducted on two saturated normally consolidated clay samples are given below. Determine the shear strength parameters by using Mohr-Coulomb failure criterion? **07**

	Sample1	***Sample2***
Confining pressure	4.8 kg/cm^2	6.3 kg/cm^2
Axial stress at failure	6.8 kg/cm^2	9.3 kg/cm^2
Pore water pressure at failure (Stage 2 specimen is sheared in undrained condition)	3.8 kg/cm^2	4.8 kg/cm^2

OR

Q.5 **(a)** Define: **03**

a) Immediate settlement
b) Primary consolidation settlement
c) Secondary consolidation settlement

(b) For a field pumping test, a well was sunk through a horizontal stratum of sand 14.5 m thick and underlain by a clay stratum. Two observation wells were sunk at horizontal distances of 16m and 34m respectively from the pumping well. The initial position of the water table was 2.2 m below ground level. At a steady state pumping rate of 925 litres/ min, the drawdowns in the observation wells were found to be 2.45 m and 1.20 m respectively. Calculate the coefficient of permeability of the sand? **04**

(c) A UU test is carried out on a saturated normally consolidated clay sample at a confining pressure of 3 kg/cm^2.The deviator stress at failure is 1 kg/cm^2. **07**

a) Determine its total stress strength parameters.
b) If another identical sample is tested at a confining pressure of 4 kg/cm^2, what will be the vertical axial stress at failure?

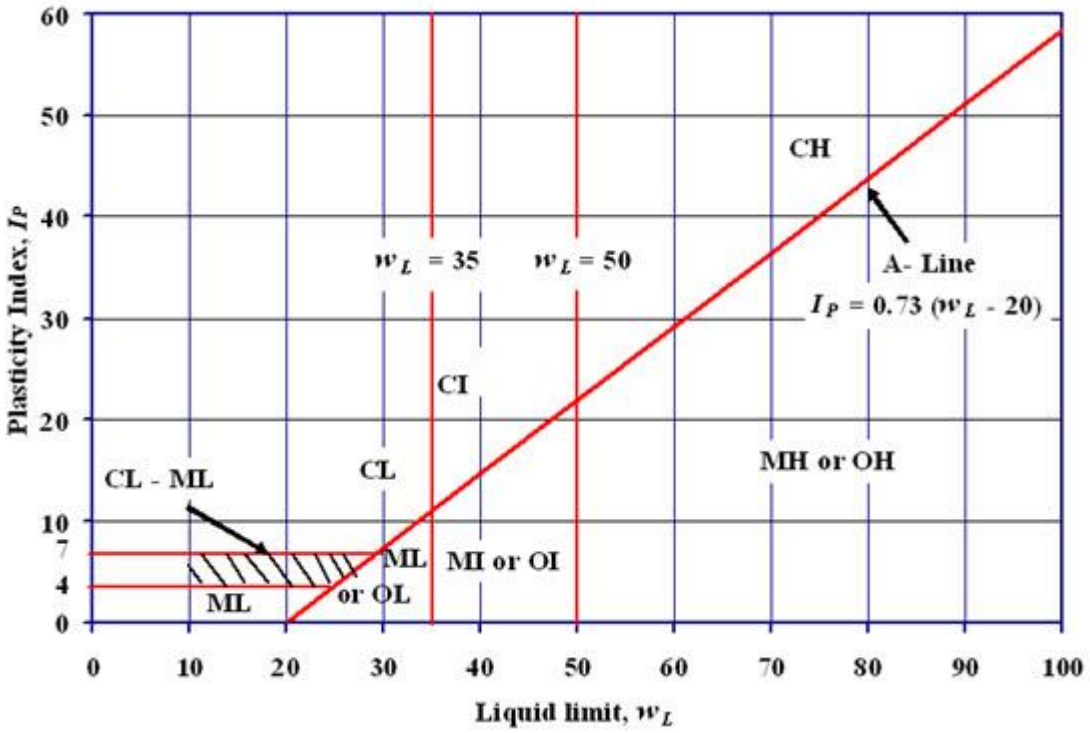


Figure 1 Plasticity chart as per Indian Standard Soil Classification System

Table 1 Constant K versus Temperature T (°C)

Temparature (°C)	G_s							
	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80
16	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374
17	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356
18	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339
19	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.01323
20	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307
21	0.01438	0.01414	0.01391	0.01369	0.01348	0.01328	0.01309	0.01291
22	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276
23	0.01404	0.01391	0.01358	0.01337	0.01317	0.01297	0.01279	0.01261
24	0.01388	0.01365	0.01342	0.01321	0.01301	0.01282	0.01264	0.01246
25	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232
26	0.01357	0.01334	0.01312	0.01291	0.01272	0.01253	0.01235	0.01218
27	0.01342	0.01319	0.01397	0.01277	0.01258	0.01239	0.01221	0.01204
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01225	0.01208	0.01191
29	0.01312	0.01290	0.01269	0.01249	0.01230	0.01212	0.01195	0.01178
30	0.01298	0.01276	0.01256	0.01236	0.01217	0.01199	0.01182	0.01169

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