Ref. No. CON/PC/B/T/223/2022

B. E. CONSTRUCTION ENGINEERING 2ND YEAR 2ND SEMESTER - 2022

SUBJECT: Soil Mechanics I

Time : Three Hours **Full Marks : 50**

Part I

<table>
<tr><th></th><th>Question No.</th><th colspan="5"></th><th>Marks</th></tr>
<tr><td>CO1 [07]</td><td></td><td colspan="5">Answer any one from question (1) and question (2) in this block</td><td></td></tr>
<tr><td></td><td>Q1.</td><td colspan="5">Liquid limit test was conducted on a soil sample. The test data are as follows :</td><td>07</td></tr>
<tr><td></td><td></td><td>Number of blows :</td><td>31</td><td>35</td><td>28</td><td>18</td><td></td></tr>
<tr><td></td><td></td><td>Weight of wet soil and container :</td><td>25.93</td><td>25.27</td><td>53.99</td><td>24.89</td><td></td></tr>
<tr><td></td><td></td><td>Weight of dry soil and container :</td><td>23.97</td><td>23.98</td><td>52.30</td><td>23.40</td><td></td></tr>
<tr><td></td><td></td><td>Weight of container :</td><td>20.96</td><td>21.99</td><td>49.74</td><td>21.23</td><td></td></tr>
<tr><td></td><td></td><td colspan="5">Calculate the liquid limit of the soil sample.</td><td></td></tr>
<tr><td></td><td>Q2a.</td><td colspan="5">For a fine grained soil the following test data are obtained
Liquid limit : 55%
Plastic Limit : 22%
Natural Moisture content : 40%
% finer than 75 micron = 20%
Find (i) Plasticity index (ii) Liquidity Index (iii) Activity Number Comment on the consistency and expansive characteristics of the soil based on the above test results.</td><td>05</td></tr>
<tr><td></td><td>Q2b.</td><td colspan="5">State whether the following statements are True or False.</td><td>02</td></tr>
<tr><td></td><td>i)</td><td colspan="5">Clay is an aggregate of microscopic and submicroscopic particles derived from the chemical decomposition of rock constituents.</td><td></td></tr>
<tr><td></td><td>ii)</td><td colspan="5">Peat is a incompressible material</td><td></td></tr>
</table>

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Part I

	Question No.		Marks
CO2 [10]		**Answer any one from question (3), question (4) and question (5) in this block**	
	Q3.	The combined grain size analysis of a soil sample is carried out. The test data are as follows.	10

SIEVE ANALYSIS

Sieve size (mm)	4.75	2.00	1.18	0.60	0.425	0.30	0.15	0.075
Weight retained (gm)	–	–	0.01	0.02	0.03	0.17	0.12	0.46

HYDROMETER ANALYSIS

Time (minutes)	0.5	1.0	2.0	4.0	8.0	15.0	30.0	60.0	120.0	1440.0
Hydrometer reading	1.030	1.029	1.028	1.024	1.0185	1.014	1.010	1.009	1.007	1.005

Total soil sample taken for test = 50 gm

Specific gravity of soil solid = 2.67

Viscosity of water = 7.83milipoise

Specific gravity of water = 0.9963

Meniscus correction = +0.0005

Diameter of c/s area of cylinder = 7.2cm

Volume of the hydrometer bulb = 100cc

h = 16.3cm

Distance from neck to hydrometer reading 1.030 is 1.46cm

Distance between major graduations, i.e. between 1.025 & 1.030 etc. is 1.75cm.

Draw the grain size distribution curve and find out the percentage of sand, silt and clay.

	Q4.	Visual identification and laboratory test results of two nos of soil samples are as follows. Write down the classification symbol and description of the soil samples.	

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<table>
<tr><th></th><th>Question No.</th><th></th><th>Marks</th></tr>
<tr><td></td><td>i)</td><td>Colour : brownish grey
Natural moisture content: 32%
Liquid limit : 37%
Plastic Limit : 24.6%</td><td>05</td></tr>
<tr><td></td><td>ii)</td><td>Sieve analysis test results of a soil sample are given below.
<table>
<tr><td>Sieve Size (mm)</td><td>10.0</td><td>4.75</td><td>2.36</td><td>1.18</td><td>0.600</td><td>0.425</td><td>0.300</td><td>0.150</td><td>0.075</td></tr>
<tr><td>Percent finer</td><td>100.0</td><td>95.0</td><td>78.0</td><td>50.0</td><td>25.0</td><td>20.0</td><td>12.5</td><td>5.0</td><td>2.0</td></tr>
</table>
Colour: Yellowish brown
Relative density: Dense</td><td>05</td></tr>
<tr><td></td><td>Q5a.</td><td>Write short note</td><td></td></tr>
<tr><td></td><td>i)</td><td>Identification of organic soil</td><td>03</td></tr>
<tr><td></td><td>ii)</td><td>Dry strength and dilatancy test for identification of soil</td><td>05</td></tr>
<tr><td></td><td>Q5b.</td><td>If the liquid limit and plastic limit of a soil is 55% and 25% respectively, IS Classification of the soil sample will be
i) CI ii) CH iii) MI iv) MH</td><td>01</td></tr>
<tr><td></td><td>Q5c.</td><td>If D_{60}, D_{30} & D_{10} of a soil sample are 1.60mm, 1.20mm and 0.089mm respectively, find out Uniformity co-efficient and Co-efficient of curvature</td><td>01</td></tr>
<tr><td>CO3 [08]</td><td>Q6a.</td><td>State whether the following statements are True or False.
i) If the hydraulic gradient is more, discharge of water through the soil sample will be more.
ii) Sand is less permeable than clay</td><td>02</td></tr>
<tr><td></td><td>Q6b.</td><td>In a falling head permeability test the initial head (at t = 0) is 50cm. The head drops by 4cm in 12 minutes. Calculate the time required to run the test if the final head is to be 20cm.</td><td>03</td></tr>
</table>

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Part I

<table>
<tr><th></th><th>Question No.</th><th></th><th>Marks</th></tr>
<tr><td></td><td>Q6c.</td><td>Calculate the co-efficient of permeability of a soil sample 6cm in height and 50cm^2 in cross section area if a quantity of water equal to 450 ml passed down in 10 minutes under an effective constant head of 40cm. On oven drying, the test specimen weighs 495gm. Calculate the seepage velocity of water during the test. Assume G=2.65.</td><td>03</td></tr>
<tr><td>CO4 [10]</td><td>Q7.</td><td>The subsoil profile at a site is given below.
<table>
<tr><th colspan="2">Depth (m)</th><th rowspan="2">Description</th><th rowspan="2">Soil Parameters</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>0.0</td><td>6.0</td><td>Loose brownish grey silty sand</td><td>$\gamma = 1.78 t/m^3$</td></tr>
<tr><td>6.0</td><td>12.00</td><td>Medium stiff grey silty clay</td><td>$\gamma = 1.82 t/m^3$</td></tr>
<tr><td>12.00</td><td>20.00</td><td>Medium dense yellowish brown silty sand</td><td>$\gamma = 1.88 t/m^3$</td></tr>
</table>
The water table is at ground surface. Draw the variation of total, neutral and effective pressure with depth. If the water table rises to 1.00m above the ground level, what will be the change in effective pressure at 20.00m depth? Take $\gamma_w = 1.00 t/m^3$.</td><td>10</td></tr>
<tr><td>CO5 [15]</td><td></td><td>Answer any three from question (8), question (9), question (10) and question (11) in this block</td><td></td></tr>
<tr><td></td><td>Q8.</td><td>The time required for 50% consolidation of a 20mm thick clay layer (drained at both top and bottom) in the laboratory is 2 min. How long (in days) will it take for a 5m thick identical clay layer in the field under the same pressure increment to reach 50% consolidation if the clay layer is free to drain from both the top and bottom surface?</td><td>05</td></tr>
<tr><td></td><td>Q9.</td><td>A normally consolidated clay layer exists below the ground level up to a depth of 5.0m followed by layer of sand. Due to placement of a foundation at a depth of 1.0m below ground level, the pressure increment in the middle of the clay layer below the foundation is 0.30kg/cm^2. The compression index Cc and the initial void ratio of the soil are 0.35 and 1.20 respectively. The bulk density of the soil is 1.800 t/m^3. The water table is at the ground surface. Calculate the settlement of the clay layer.</td><td>05</td></tr>
<tr><td></td><td>Q10a.</td><td>Describe the method of determination of pre-consolidation pressure</td><td>02</td></tr>
</table>

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Part I

	Question No.		Marks
	Q10b.	The soil profile at a site is shown in figure. Ground water table is at a depth of 5.00m below ground level at present. The ground water table was 10.0m below the ground level in the past. Take nit weight of water = 1.00t/m^3. Assume γ = 1.750t/m^3 above water table and γ_{sat} = 1.850t/m^3 below water table. Find out the over consolidation ratio at the midpoint of the clay layer. Ground level Present ground water table Sand 5.00m 15.00m Clay γ_{sat} = 1.700t/m^3 23.00m	03
	Q11a.	During a consolidation test, void ratio changed from 0.7738 to 0.7714 when the pressure applied from zero to 0.25 kg/cm^2. The initial height of the specimen is 20.0mm. Calculate the change in height of the specimen due to pressure increment. Also calculate the co-efficient of volume compressibility.	03
	Q11b.	For a clay soil, the co-efficient of permeability and co-efficient of volume compressibility are 1x10^{-7} cm/sec and 0.0300cm^2/kg. Find out the co-efficient of consolidation.	02

B.E Construction Engineering 2nd year 2nd semester examination 2022

Soil Mechanics-I

EX/CON/PC/B/T/223/2022

Part-II

Full Marks-50 Time – 3 hours

Assume relevant data if required. In this paper where numerical data contains the word 'A' means the last digit of your examination roll number.

Answer any two questions.

Q-1. Following data refres to a standard proctor test conducted in a laboratory.

Water content (%)	8.5	12.3	13.75	15.5	18.2	20.2
Weight of moist sample (kg)	1.8	1.94	2.0	2.05	2.03	1.98

Consider Sp gravity of soil solid as 2.A

(a) Draw the moisture density curve and determine maximum drydensity and optimum moisture content . (12)

(b) Draw zero air void line curve. (6)

© Explain sand replacement method with its objective . (7)

Q-2. The results of a series of CU tests conducted on clayey sample are given below. Determine the shear strength parameters with respect to total as well as effective stresses using Mohr circle and compare the results obtained using numerical approach. (20)

Cell pressure (kN/m^2)	100	300	500
Deviator stress at failure (kN/m^2)	13A	48A	64A
Pore pressure at failure (kN/m^2)	4A	14A	29A

Compare the results obtained using numerical approach

(b) Can the shear strength parameter of soil be obtained using unconfined compression test with higher reliability. Justify your answer.

Q-3.

(a) Define void ratio , degree of saturation, specific gravity and moisture content of a soil using block diagram and establish correlation between those parameters. (8)

(b) If 5.6 kg/cm^2 uniformly distributed load is acting on a circular area of 150 mm dia flexible circular footing , calculate and draw the variation in vertical stress up to a depth of 2.0 m below from the load surface at an incremental depth of 250 mm. (7)

© Explain the formula of vertical stress distribution for an embankment loading. (5)

(d) Write notes on 2:1 method. (5)