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Code No. : 16144 N/O

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD
Accredited by NAAC with A++ Grade

B.E. (Civil Engg.) VI-Semester Main & Backlog Examinations, May/June-2023

Soil Mechanics

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B**

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Define coefficient of uniformity and coefficient of curvature	2	1	1	1
2.	Derive the relationship between porosity and void ratio, starting from their basic definitions.	2	1	1	1
3.	Define quick sand condition.	2	1	2	1
4.	What is critical hydraulic gradient?	2	1	2	1
5.	Differentiate between Boussinesq's and Westergaard's equations.	2	1	3	1
6.	Define dry and wet of optimum. On which side can you expect more shear strength of soil?	2	1	3	1
7.	Define the different components of total settlement.	2	2	4	1
8.	What is overconsolidation ratio?	2	1	4	1
9.	What are the limitations of vane shear test?	2	1	5	1
10.	Is it possible to draw a Mohr's circle from the experimental data obtained from a direct shear test? Explain.	2	2	5	1

Part-B (5 × 8 = 40 Marks)

11. a) In order to determine the bulk density of an in-situ soil, 4.7 kg of soil was extracted from a hole at the surface of the soil. The hole required 3.65 kg of loose dry sand for its filling. If it takes 6.75 kg of the same sand to fill a calibrating can of 4.5 litre capacity, determine the bulk density of the soil.

4 3 1 2

b) The following index properties are determined for 2 soils A and B.

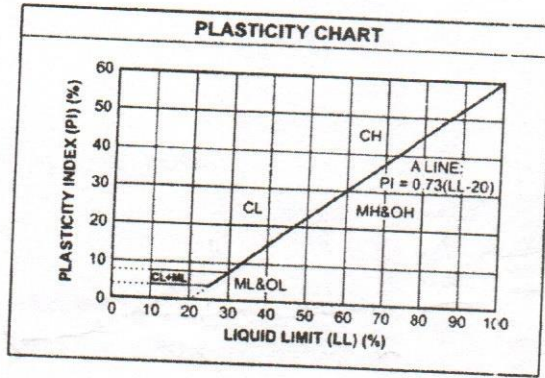
Index Property	A	B
Liquid Limit	65	35
Plastic Limit	25	20
Water Content	35	25
Specific Gravity	2.70	2.65
Degree of saturation	100%	100%

4 4 1 2

Which of the 2 soils (i) contains more clay particles, (ii) has greater bulk density, (iii) has greater dry density (iv) has greater void ratio?

12. a)	During a pumping test, a well was sunk through a stratum of dense sand 10m deep overlying an impervious stratum. Observation holes were drilled at 15m and 6.75m from the well. Initially, the water level in the well was 2.50m below the ground surface. After pumping until under steady conditions had been achieved, the water levels in the observation wells dropped by 1.95m and 0.50m respectively. If the steady discharge was 5litres/sec, determine the coefficient of permeability.	4	3	2	2
b)	A soil profile consists of a surface layer of sand 3.5m thick (density = 16.5 kg/m ³), an intermediate layer of clay 3m thick (density = 19.5 kg/m ³) and the bottom layer of gravel 3.5 m thick (density = 19.25 kg/m ³). The water table is at the upper surface of the clay layer. Determine the effective pressure at various levels immediately after placement of a surcharge load of 100 kN/m ² on the ground surface.	4	3	2	2
13. a)	An earthen embankment of 106 m ³ volume is to be constructed with a soil having a void ratio of 0.80 after compaction. There are three borrow pits marked as A, B and C, having soils with void ratios of 0.90, 1.50 and 1.80 respectively. The cost of excavation and transporting the soil is Rs. 25, Rs. 23 and Rs. 18 per m ³ respectively. Calculate the volume of soil to be excavated from each pit. Which borrow pit is most economical? (G = 2.65 for all soils).	5	4	3	2
b)	2 columns A and B are situated 6m apart. Column A transfers a load of 500 kN and column B, a load of 250 kN. Determine the resultant vertical stress on a horizontal plane 20m below the ground surface at points vertically below A and B.	3	3	3	2
14. a)	A 3m thick clay layer beneath a building is overlain by a permeable stratum and is underlain by an impervious rock. The coefficient of consolidation of the clay was found to be 0.025 cm ² /min. The final expected settlement for the layer is 8cm.	6	2	4	2
	i) How much time will it take for 80% of total settlement to take place? ii) Determine the time required for a settlement of 2.5 cm to occur. iii) Compute the settlement that would occur in 1 year.				
b)	State the assumptions of Terzaghi's one dimensional consolidation theory.	2	2	4	1
15. a)	What are the 3 different types of triaxial test? What are the different conditions in which each of these tests are used?	4	2	5	1
b)	A c-φ soil has an unconfined compressive strength of 120 kN/m ² . In a triaxial compression test, a specimen of the same soil, when subjected to a cell pressure of 40 kN/m ² failed at a deviatoric stress of 160 kN/m ² . Determine the shear strength properties (both c and φ) of soil.	4	3	5	2

16. a) The sieve analysis of a soil gave the following results:
 % passing through 75 μ m sieve = 8%, % retained on 4.75 mm sieve = 65%
 $D_{10} = 0.95$, $D_{30} = 3.9$, $D_{60} = 6.75$
 Liquid limit and plastic limit of the soil are 17 and 12 respectively.
 Classify the soil according Unified Soil Classification System, clearly explaining each step.



4 2 1 2

- b) Derive Laplace's equation for a 2 dimensional flow of water through a homogenous saturated soil mass having similar coefficients of permeability in both directions.

4 2 2 1

17. Answer any *two* of the following:

- a) The maximum dry density of a sample by light compaction test is 1.78 gm/cc at an optimum moisture content of 15%. Find the air voids and degree of saturation. $G = 2.67$. What would be the corresponding value of dry density on the zero air void line at OMC?

4 3 3 2

- b) There is a clay layer 8m thick with a layer of sand on either side. An undisturbed sample of the clay 2.5 cm thick, when tested in the laboratory in a floating ring oedometer required 25 minutes to reach 50% consolidation. It is proposed to construct a building at the above site. Estimate the time (in days) required for 90% consolidation to take place.

4 4 4 2

- c) A field vane testing instrument having height 100 mm and diameter 50 mm was inserted completely into a deposit of soft, saturated silty clay. Upon application of a rapidly increasing torque about the vane rod, the soil was found to fail when the torque reached 4.6 Nm. Assuming mobilization of undrained shear strength on all failure surfaces to be uniform and the resistance mobilized on the surface of the vane rod to be negligible, what would be the peak undrained shear strength of the soil in kN/m^2 ?

4 3 5 2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level - 1	20%
ii)	Blooms Taxonomy Level - 2	30%
iii)	Blooms Taxonomy Level - 3 & 4	50%
