Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) (FT/WP/PT) Exam April 2025 (2019 Scheme)

Course Code: CET204

Course Name: GEOTECHNICAL ENGINEERING – I

Max. Marks: 100 Duration: 3 Hours

Graph sheets and Semi log sheets can be used wherever it is necessary

PART A

(Answer all questions; each question carries 3 marks) Marks

1		Establish a relationship between void ratio and porosity.	3
2		Compare the effects of flocculated and dispersed structures on soil strength.	3
3		Write a note on the use of the plasticity chart in classifying fine-grained soils.	3
4		List any 6 factors affecting permeability.	3
5		How does capillarity affect the effective stress in soils?	3
6		Explain 2:1 distribution method for determining vertical stress.	3
7		Give the equation for magnitude of settlement of normally consolidated clays.	3
8		Explain the terms i) OMC ii) MDD iii) Zero air void line.	3
9		Describe the procedure of the unconfined compression test.	3
10		Explain the difference between toe failure and base failure.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Write a note on any three major soil deposits in India.	6
	b)	A core cutter of internal diameter 10 cm and height 12.5 cm is driven into the soil. The weight of the soil-filled core cutter is 2.75 kg. The weight of the empty core cutter is 1.45 kg. Determine: a) The bulk density of the soil. b) If the moisture content of the soil is 15%, calculate the dry density.	8
12	a)	With the help of phase diagram, establish the relationship between bulk density, degree of saturation, void ratio and specific gravity.	6
	b)	The saturated unit weight of a clay sample is 20.4 kN/m^3 at 25% water content. What is the specific gravity and void ratio of the sample? (take γ_w=9.81kN/m^2)	8

Module -2

13	a)	Following are the results obtained from the liquid and plastic limit tests for a soil.	10

Number of Blows	Moisture Content(%)

14	35
22	28
31	20

Given that the plastic limit is 18%.

(i) Draw the flow curve and obtain the liquid limit.

(ii) Calculate Plasticity index.

(iii) Determine the liquidity index of soil when the in-situ moisture content is 22%.

b) Classify the given soil and provide justification based on the following properties: Coefficient of Uniformity (Cu) = 7.5, Coefficient of Curvature (Cc) = 1.8, Gravel content = 80%, and Sand content = 20%. 4

14 a) What are the corrections applied to hydrometer analysis? 6

b) A civil engineer is analysing a horizontally stratified soil profile at a construction site. The deposit consists of three distinct, uniform soil layers with permeabilities of 5.5×10^{-4} cm/sec, 8×10^{-4} cm/sec, and 3.1×10^{-4} cm/sec, and respective thicknesses of 4m, 3m, and 7.5m. Determine the ratio of the effective average permeability in the horizontal direction to that in the vertical direction to aid in assessing groundwater flow characteristics. 8

Module -3

15 a) A soil profile consists of a 3 m thick silt layer (unit weight = 18.4 kN/m³) overlying a 2.5 m thick sand layer (saturated unit weight = 19.8 kN/m³), which rests on impermeable rock. The water table is at 3m below the ground surface. Saturated unit weight of silt layer is 19.2 kN/m³. A piezometer installed in the sand shows water rising to 1m above the water table. Plot the distribution of total stress, pore water pressure, and effective stress with depth. (Use $\gamma_w = 9.81$ kN/m³) 10

b) What is the quick sand condition in soil mechanics? 4

16 a) A circular footing of radius 2 m is subjected to a uniform pressure of 150 kPa. The soil is assumed to be homogeneous, elastic, and isotropic. 8

i. Using Boussinesq's theory, compute the vertical stress at a depth of 3 m directly beneath the center of the footing.

ii. Determine the vertical stress at a depth of 5 m directly beneath the center of the footing

iii. Compare the two values and discuss the influence of depth on stress distribution beneath a loaded area.

b) Explain the concept of a pressure bulb and its significance in soil mechanics. 6

Module -4

17 a) In a laboratory consolidation test, a saturated clay sample 25 mm thick reaches 50% consolidation in 8 minutes. The sample is drained on both sides. At a construction site, the clay layer 6 m thick (with an impervious base) is subjected to the same load increment as in the lab test. Estimate the time required for 50% consolidation in the field. Calculate the time required to reach 90% consolidation in the same field layer. If the field clay layer had double drainage, what would be the new time required to reach 50% consolidation? (Express all time values in years, rounded to two decimal places.) 8

b) Explain the terms i) Coefficient of consolidation ii) Compression Index iii) Time factor. 6

18 a) The optimum moisture content (OMC) and maximum dry density (MDD) of a soil obtained from the standard Proctor test are 20% and 1.75g/cc, respectively. The specific gravity (G) of the soil solids is 2.75. 7

i. Calculate the degree of saturation of the soil at the OMC.

ii. Determine the dry density corresponding to a zero air voids condition at the OMC.

b) Explain the different methods of field compaction used in construction. 7

Module -5

19 a) Plot the failure envelopes derived from shear tests conducted on pure sand and pure clay samples. Distinguish between the characteristics of the envelopes for each soil type. 6

b) In a direct shear test, the soil sample failed under a normal stress of 30 kN/m² and a shear stress of 24 kN/m². The cohesion of the soil is 10 kN/m². Construct the Mohr's circle representing the stress condition at failure. Determine the principal stresses acting on the sample. Calculate the orientation of the principal planes with respect to the horizontal. 8

20 a) Discuss the Swedish circle method for slope stability analysis. 8

b) A slope is to be constructed in cohesive soil with a cohesion value of 30 kN/m² and an internal friction angle (Φ) of 0°. The unit weight of the soil is 19 kN/m³. If the slope is to be formed with a side slope of 2:1 and a factor of safety of 1.6, determine the maximum permissible height of the slope. Use Taylor's stability number = 0.15. 6

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