Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/PT) Examination December 2025/January 2026 (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		A given soil sample has a water content of 20% and a wet unit weight of 18 kN/m^3. Determine dry unit weight, void ratio and degree of saturation of soil if G= 2.67 and $\gamma_w = 10\ kN/m^3$.	3
2		Explain the determination of water content by oven drying method.	3
3		Determine the relative density of a soil sample if $e_{max} = 0.85, e_{min} = 0.4$ and void ratio in natural state is 0.6.	3
4		Permeability of soil is influenced by various factors. Justify with any three factors.	3
5		Explain quick sand condition and critical hydraulic gradient.	3
6		What is Newmark's chart and what are its uses?	3
7		Differentiate between compaction and consolidation. Give any three points.	3
8		Explain normally consolidated, under consolidated and over consolidated soils using loading, unloading, reloading plot.	3
9		What are the different types of slope failures? Explain with neat sketches.	3
10		For what type of soil is unconfined compression test suitable? Determine the undrained cohesion of a soil sample whose unconfined compressive strength is 250 kPa.	3

PART B

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

Module -1

11	a)	Explain the determination of field density by core cutter method.	6
	b)	A 1000 cm^3 core cutter weighs 950 g. The weight of core cutter filled with soil was found to be 2800 g. Determine the bulk density, dry density, void ratio and degree of saturation of the sample. The soil sample was found to have a water content of 12% and G of 2.65.	8

12 a) Derive the relation: $\gamma = \frac{G+Se}{1+e}.\gamma_w$ using fundamental relations. 5

b) A saturated soil sample has a water content of 30 % and a bulk unit weight of 20 kN/m^3. Determine the dry unit weight, void ratio, porosity, % air voids and specific gravity of the solids. Take $\gamma_w = 10\ kN/m^3$. 9

Module -2

13 a) What are consistency limits? Explain the different consistency limits with water content vs. volume graph. 4

b) The liquid limit, plastic limit, water content and flow index of fully saturated soil samples are respectively: Soil sample 1: 60%, 30%, 45%, 15%; Soil sample 2: 40%, 15%, 20%, 20%. Determine which of the two samples have higher: (i) plasticity index; (ii) liquidity index; (iii) consistency index; and (iv) toughness index (v) higher clay fraction. 10

14 a) Explain the laboratory procedure adopted for determining permeability using falling head permeability test with a neat figure. 8

b) A falling head permeability test was conducted on a soil sample with 15 cm height and 4 cm diameter. The standpipe has an internal diameter of 1.12 cm. The water level in stand pipe dropped from a height of 75 cm to 25 cm in 20 minutes. Find the coefficient of permeability. 6

Module -3

15 a) What are pressure isobars? With a neat sketch explain pressure bulb. 5

b) A sand deposit 4 m thick has the following subsoil conditions. The water table is at a depth of 2m from the ground surface and a zone of capillary saturation exists 2 m above the water table extending up to the ground surface. The sand has G value of 2.6 and void ratio of 0.6. Obtain the variation of total stress, neutral stress and effective stress and plot the same. Take $\gamma_w = 10\ kN/m^3$. 9

16 a) A concentrated load of 500 kN is applied at the ground surface. Determine vertical stress at: i) Point P which is 5m directly below the load; and ii) Point Q at a depth of 5m but at a radial distance of 4m from axis of load 7

b) A square foundation of size 2m by 2m carries a uniformly distributed load of 20kN/m^2. Determine the vertical stress at a P which is at the centre of the square and at depth of 5m below the square foundation. Use equivalent point load method. 7

Module -4

17 a) Explain average degree of consolidation, time factor, coefficient of consolidation and coefficient of volume compressibility. 4

b) A 5 m thick clay layer beneath a building undergoes double drainage and has a coefficient of permeability of 0.03 m/yr. The time taken for 50% consolidation to occur is 1 year. Determine the coefficient of consolidation, coefficient of volume compressibility and the final settlement of the stratum if it is subjected to an increase in pressure of 50 kPa. Take $\gamma_w = 10\ kN/m^3$. 10

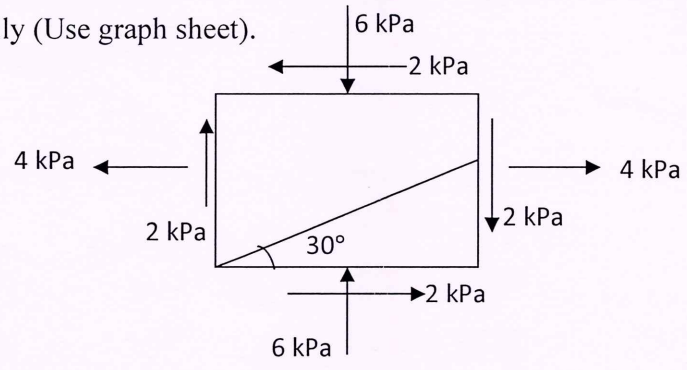
18 a) Plot the compaction curve of standard and modified proctor test and comment on OMC and MDD of both tests. Also plot the zero air voids line. 4

b) Following results were obtained from a proctor compaction test. Plot the compaction curve and obtain OMC and MDD. Also obtain the theoretical maximum dry density corresponding to each water content if G=2.6. (Use graph sheet) 10

Water content (%)	Bulk density (g/cc)
12	1.7
14	1.9
16	2
18	1.97
20	1.88
22	1.75

Module -5

19 a) Figure shows an element with stress as indicated. Determine the (a) magnitude of the major and minor principal stresses, (b) the stresses on a plane inclined at 30^0 to horizontal and (c) the maximum shear stress and the plane on which it acts graphically (Use graph sheet). 10



b) What are the advantages and disadvantages of direct shear test? 4

20 a) Explain the friction circle method of slope stability analysis with neat figure. 8

b) A submerged embankment 30 m high have a slope of 45°. The properties of embankment soil are: $c = 35\ kN/m^2$, $\phi = 10°$; $\gamma_{sat} = 20\ kN/m^3$. Find the factor of safety with respect to cohesion. Adopt Taylor's stability number as 0.108. Take $\gamma_w = 10\ kN/m^3$. Is the slope safe? 6

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