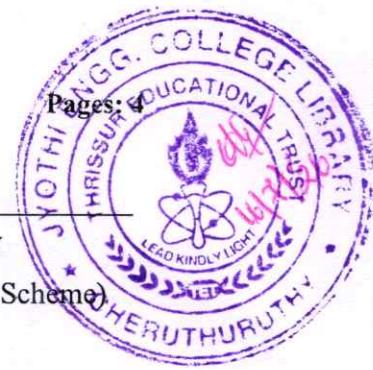




Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/PT) Examinations April/May 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 equal volume of solids and voids. Determine the void ratio and porosity of the sample. 3
- 2 Differentiate between sensitivity and thixotropy of soil. If a soil sample has sensitivity value less than 1, comment on the soil type. 3
- 3 A soil has liquid limit of 30%, plastic limit of 10 % and natural condition water content of 20%. If the toughness index of the soil is 40 %, determine the plasticity index, flow index and liquidity index. 3
- 4 State Darcy's Law and comment on coefficient of permeability. 3
- 5 What causes quick condition in soil? If a soil has a specific gravity of 2.65 and void ratio of 0.65, at what gradient will soil behave as quick. 3
- 6 Differentiate and explain the between pressure isobars and pressure bulbs with a neat sketch. 3
- 7 Plot a typical compaction curve and explain OMC and MDD. 3
- 8 A clay stratum 4 m thick has an initial void ratio of 1.4. When the sample is subjected to an increase in pressure, the void ratio reduces to 1.33. Determine the final settlement of the stratum. 3
- 9 What is rotational failure of slope? Explain the three types of rotational slope failure using neat sketches. 3
- 10 Explain Mohr-Coulomb failure criterion. 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 sand replacement method. 8
- b) An embankment needs to be constructed using 30,000 m³ of soil and have a void ratio of 0.7. There are two borrow areas nearby– area 1 and area 2. Area 1 borrow 6

pit soil have a void ratio of 0.9 and the transportation cost of the site soil to embankment area is Rs. 20/m³. Area 2 borrow pit soil have a void ratio of 1.2 and the transportation cost of the site soil to embankment area is Rs. 10/m³. Which borrow pit is more economical?

- 12 a) Explain the procedure to determine specific gravity of sandy soil sample using pycnometer. 4
- b) A sample of wet soil has a volume of 0.022 m³ and a mass of 40 kg. When the sample is dried in oven its mass reduces to 34 kg. The specific gravity of sample is 2.7. Determine bulk density, water content, dry density, saturated density, void ratio, porosity, degree of saturation and percentage air voids of the sample. 10

Module -2

- 13 a) Enumerate the procedure used for determination of liquid limit in laboratory using Casagrande's apparatus with neat sketches. 8
- b) Classify the soil as per ISC system. The analysis of soil gave the following results: 6
 % passing 75 μ sieve = 10; % retained on 4.75 mm sieve = 40; Uniformity coefficient = 8; coefficient of curvature = 4; Plasticity index = 8; and Liquid limit = 30.
- 14 a) Explain the laboratory procedure adopted for determining permeability using constant head permeability test with a neat figure. 8
- b) Determine the ratio of average coefficient of permeability in the horizontal to vertical direction for an isotropic deposit consisting of 4 layers of thickness 4m, 3m, 2m and 2.5 m having coefficients of permeability 3×10^{-2} mm/sec, 2×10^{-4} mm/sec, 4×10^{-5} mm/sec and 5×10^{-3} mm/sec respectively. 6

Module -3

- 15 a) Sketch the contact pressure distribution below a flexible and rigid footing in sand and clay. 4
- b) A sand deposit consists of 2 layers. The top layer is 2m thick having $\gamma = 17$ kN/m³ and bottom layer is 5 m thick having $\gamma_{sat} = 20$ kN/m³. The water table is at a depth of 3m from the ground surface and a zone of capillary saturation exists 1.m above the water table. Obtain the variation of total stress, neutral stress and effective stress and plot the same. 10
- 16 a) A concentrated load of 1000 kN is applied at the ground surface. Determine vertical stress at: 7

- i) Point P which is 7m directly below the load
 ii) Point Q at a depth of 5m but at a radial distance of 4m from axis of load
 iii) Point R at a depth of 1m and at a radial distance of 2m from axis of load
- b) A square foundation of size 4m by 4m carries a uniformly distributed load of 200kN/m². Determine the vertical stress at a P which is at the centre of the square and at depth of 5m below the square foundation. The influence coefficients are

given below:

m	n			
	0.2	0.4	0.6	0.8
0.2	0.0179	0.0328	0.0435	0.0504
0.4	0.0328	0.0602	0.0801	0.0931
0.6	0.0435	0.0801	0.1069	0.1247
0.8	0.0504	0.0931	0.1247	0.1461

Module -4

- 17 a) What is pre-consolidation pressure? Explain its determination procedure with a neat figure. 6
- b) A 4 m thick clay layer beneath a building undergoes double drainage. The coefficient of consolidation of clay was found to be 0.03cm²/min. The final expected settlement for layer is 10 cm. Determine the time in days it will take for 40% of consolidation to be complete. Also estimate the time required in days for a settlement of 8 cm to occur. 8
- 18 a) Explain any 2 field compaction methods suitable for cohesionless soil in detail. 4
- b) List the laboratory tests adopted to determine the amount of compaction and water content required in field. Enumerate with neat sketch the laboratory procedure adopted to find optimum moisture content and maximum dry density when very heavy loads are considered to act in field. 10

Module -5

- 19 a) The following results were obtained from a CU test on NC clay. Obtain the shear strength parameters by graphically plotting the strength envelope in terms of effective stress. (Use graph sheet) 10

Sample No.	Cell pressure (kPa)	Deviator stress (kPa)	Porewater pressure (kPa)
1	350	210	160
2	550	334	250
3	750	500	300

b) Determine the shear strength of soil sample from the following vane shear test 4

data: Torque applied = 4200 N cm, diameter of vane = 1.2 cm, height of vane = 2.4 cm.

20 a) Explain the procedure adopted for direct shear testing of soil with a neat figure and 9

sketch the typical failure envelope of the test.

b) A vertical cut is made in a clay deposit having $c = 35 \text{ kN/m}^2$, $\phi = 0$; $\gamma = 5 \text{ kN/m}^3$. Find the maximum height of the cut which can be made so that it can stand unsupported. Adopt Taylor's stability number as 0.261.
