Reg. No.												

Question Paper Code	13047

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Fourth Semester

Civil Engineering

20CEPC403 - SOIL MECHANICS

Regulations - 2020

(Use of Taylor's Stability Chart is Permitted)

Duration: 3 Hours   Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The best soil as a foundation material amongst the following is _____	1	K1	CO1
	(a) Bentonite soil (b) Desert soil (c) Laterite soil (d) Marine deposit			
2.	The water content of a soil at which the soil volume becomes constant is called	1	K1	CO1
	(a) Liquid limit (b) Plastic limit (c) Shrinkage limit (d) Solid limit			
3.	Compaction is a _____	1	K1	CO1
	(a) Gradual process of volume reduction under sustained loading			
	(b) Process by which soil particles are naturally rearranged and packed together into closer state of contact			
	(c) Process by which soil particles are artificially rearranged and packed together into closer state of contactby mechanical means			
	(d) None of these			
4.	Capillary water in soils	1	K1	CO2
	(a) Causes negative pore pressure (b) Reduces effective pressure			
	(c) Reduces bearing capacity (d) All of these			
5.	The permeability of a soil sample depends upon	1	K1	CO2
	(a) Size of the particle (b) Shape of the particle (c) Void ratio (d) All of these			
6.	The total head at any point on soil may be regarded as _____ per unit weight of water measured	1	K1	CO2
	(a) Hydraulic potential (b) Piezometric energy (c) Potential energy (d) Velocity energy			
7.	The vertical pressure distribution on any horizontal plane at a depth z below the ground due to concentrated load is _____	1	K1	CO3

(a) $\sigma_z = K_B \dfrac{Q}{z^2}$ (b) $\sigma_z = K_B \dfrac{z^2}{Q}$ (c) $\sigma_z = K_B \dfrac{z^3}{Q}$ (d) $\sigma_z = K_B \dfrac{Q}{z^3}$

		Marks	K – Level	CO
8.	Consider the following statements:	1	K2	CO3

1.   Secondary consolidation occurs at constant effective stress
2.   Secondary consolidation is related to dissipation of pore water pressure
3.   Secondary consolidation occurs due to the readjustment of soil skeleton after a disturbance during primary consolidation
4.   Rate of secondary consolidation is controlled by the viscous adsorbed layer surrounding clay particle in soil

(a) 1, 2 and 3   (b) 2, 3 and 4   (c) 1, 3 and 4   (d) All of the above

		Marks	K – Level	CO
9.	The slope of the e – logp curve for a soil mass gives _____	1	K1	CO3
	(a) coefficient of permeability (b) coefficient of consolidation			
	(c) coefficient of volume change (d) compression index			

10. The shear strength of soil _____   1   K2   CO4
    (a) increases with an increase in the normal stress
    (b) is proportional to the cohesion of the soil
    (c) is generally known as the strength of the soil
    (d) All of the above
11. Mohr's circle can be drawn _____   1   K2   CO4
    (a) at the time of loading   (b) before loading
    (c) during testing   (d) at failure condition only
12. According to the Mohr – Coulomb failure criterion in soils, which of the following   1   K2   CO4
    statements are incorrect?
    A: Shear strength is attribute to interlocking of soil particles and cohesion
    B: Shear strength is only attribute to the internal friction between particles
    C: The Y – intercept represents frictions of soils
    D: The Mohr – Coulomb envelop is a straight line
    (a) A and C   (b) A and D   (c) B and C   (d) B and D
13. Direct shear test can be conducted for _____   1   K2   CO5
    (a) CD drainage conditions   (b) CU drainage conditions
    (c) UU drainage conditions   (d) All of these
14. Assertion (A): In the box shear test, the failure plane is predetermined and horizontal   1   K2   CO5
    Reason (R): The shear stress is applied in the vertical direction
    (a) Both A and R are true and R is the correct explanation of A
    (b) Both A and R are true but R is not a correct explanation of A
    (c) A is true but R is false
    (d) A is false but R is true
15. Which of the following tests is conducted to assess shear strength parameter of the soil?   1   K2   CO5
    (a) compaction test   (b) hygrometer test   (c) triaxial test   (d) vane shear test
16. The soil most susceptible to liquefaction are _____   1   K1   CO5
    (a) saturated clays of uniform size
    (b) saturated fine and medium sands of uniform particle size
    (c) saturated dense sand
    (d) saturated gravels and cobbles
17. For a base failure, the depth factor D_f is _____   1   K1   CO6
    (a) 0   (b) 1   (c) between 0 and 1   (d) greater than 1
18. During stability analysis, the term mobilized shear strength means _____   1   K1   CO6
    (a) applied shear stress   (b) maximum shear stress
    (c) minimum shear stress   (d) shear strength
19. The largest value of stability number is _____   1   K1   CO6
    (a) 0.261   (b) 0.561   (c) 1.911   (d) 2.911
20. Identify the incorrect statement: 1   K2   CO6
    The stability of a slope is decreased by _____
    (a) pore water pressure in the soil
    (b) providing a beam at the toe
    (c) removal of a part of slope by excavation
    (d) shock caused by an earthquake

PART - B (10 × 2 = 20 Marks)
Answer ALL Questions

21. The void ratio of a soil sample is given by 0.58. What is the porosity of soil sample?   2   K2   CO1

22. What is the activity of clay and sensitivity of clay?   2   K1   CO1

23. List out the various forms of soil water.   2   K1   CO2

24. What is quick sand?   2   K1   CO2

25. Define isobar and isochrones.   2   K1   CO3

26. What will be the value of time factor, if the degree of consolidation is 40%?   2   K2   CO3

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13047**

27. What are the sign conventions used for normal and shear stresses in the construction of Mohr's Circle?	2	K1 CO4
28. What is the potential failure plane in Mohr-Coulomb theory?	2	K1 CO4
29. Mention any four laboratory test to find the shear strength of soil.	2	K1 CO5
30. Define Taylor's stability number.	2	K1 CO6

PART - C (6 × 10 = 60 Marks)
Answer ALL Questions

31. a) i) The bulk density and dry density of a partially saturated soil sample are 1.95g/cc and 1.80g/cc respectively. The specific gravity of solids is 2.68. Determine its void ratio, moisture content and degree of saturation. `4  K3  CO1`

   ii) A clayey soil has saturated moisture content of 15.8%. The specific gravity of soil is 2.72. Its saturation percentage is 70.8%. The soil is allowed to soak up water. After some time, the saturation increases to 90.8%. Find out the water content of the soil in later case. `6  K3  CO1`

OR

   b) Soil is to be excavated from a borrow pit, which has a density of 1.75g/cc and water content of 12%. The specific gravity of soil particles is 2.7. The soil is compacted so that water content is 18% and the dry density is 1.65g/cc. For 1000m^3 of soil in fill, estimate (i) Quantity of soil to be excavated from the pit in m^3 (ii) Amount of water to be added. Also determine the void ratios of the soil in borrow pit and fill. `10  K3  CO1`

32. a) A sand deposit is 10m thick and overlies a bed of soft clay. The groundwater table is 3m below the ground surface. If the sand above the groundwater table has a degree of saturation 45%. The void ratio of the sand is 0.7. Take $G_s = 2.65$.
   (i) Plot the diagram showing the variation of total stress, pore water pressure and the effective stress.
   (ii) Determine the increase in the effective pressure at 10m below GL, if the water table is lowered by 5m. `10  K3  CO2`

OR

   b) A horizontal stratified soil deposit consists of three layers each uniform in itself. Permeability's of these layers are 8×10^{-4}cm/s, 5.2×10^{-4}cm/s and 6×10^{-4}cm/s and their thicknesses are 7m, 3m and 10m respectively. Find the effective average permeability of the deposit in the horizontal and vertical directions. `10  K3  CO2`

33. a) Apply Bousinessq's equation to derive an expression for the stress at any depth below the center of a circular area carrying a uniformly distributed load. `10  K3  CO3`

OR

   b) Derive the equation for Terzaghi's theory of one dimensional consolidation with a neat sketch. `10  K3  CO3`

34. a) Explain Mohr's coulomb failure theory. Derive the relation between principal stresses at failure and shear strength parameters. `10  K3  CO4`

OR

   b) In a vane shear test conducted in a soft clay deposit failure occurred at a torque of 42 N-m. Afterwards the vane was allowed to rotate rapidly and the test was repeated in the remoulded soil. The torque at failure in the remoulded soil was 17 N-m. Calculate the sensitivity of the soil. In both cases, the vane was pushed completely inside soil. The height of vane and diameter across blades are 100mm and 80mm respectively. `10  K3  CO4`

35. a) Describe how the triaxial compression test is carried out under different drainage conditions.   *10   K2   CO5*

<div align="center">OR</div>

   b) Describe how Skempton's A and B parameters are used to calculate the effective stress in soils under undrained loading conditions.   *10   K2   CO5*

36. a) A canal is to be excavated to a depth of 6m below ground level, through a soil having the following characteristics: $c = 15kN/m^2$, $\varphi = 20°$, $e = 0.9$ and $G = 2.67$. The slope of the bank is 1 in 1. Determine the factor of safety with respect to cohesion when the canal runs full. What will be the factor of safety if the canal is rapidly emptied completely?   *10   K3   CO6*

<div align="center">OR</div>

   b) An embankment 10m high is inclined at an angle of 35° to the horizontal. A stability analysis by the method of slice gave the following forces per unit length: *10   K3   CO6*
ΣShearing forces = 440 kN
ΣNormal forces = 880 kN
ΣNeutral forces = 200 kN
The length of the failure arc is 26m. Laboratory tests on the soil indicated the effective values c' and φ' as 20 kN/m^2 and 18° respectively. Determine the factor of safety of the slope with respect to (a) shear strength and (b) cohesion.