

Seat No.:	Q. Paper Code: FTC-A-022			SET	A	
	Fabtech Technical Campus, College of Engineering & Research, Sangola					
	(An Autonomous Institute)					
	Geotechnical Engineering					
	Academic Year: -2025-26, Semester-I					
Unsaturated Soil Mechanics (25PCE11273)						
Regular End Semester Examination Winter 2025-26 [Dec./Jan]						
Class:	F. Y. M. Tech.	Day & Date:	Saturday, 10/01/2026			
Duration:	03 Hrs.	Max. Marks:	60 Marks			
Time:	11:00 AM TO 2:00 PM					
Instructions:						
1) All Questions are compulsory. 2) Figures to the right indicate full marks. 3) Draw neat diagram wherever necessary. 4) Make suitable assumptions if necessary and state it clearly. 5) Use of non-programmable calculator is allowed.						
Q. No.	Questions			Marks	CO	BL
Q. 1	Attempt any two of the following			12		
a)	What is pore water pressure (u) in an unsaturated soil? How does it differ from pore water pressure in saturated soils?			6	1	3
b)	Define unsaturated soil. How does it differ from saturated and dry soil in terms of three-phase composition?			6	1	3
c)	Differentiate between matric suction and osmotic suction. What are their sources and effects on soil behavior?			6	1	3
Q. 2	Attempt any two of the following			12		
a)	State Darcy's Law for saturated flow. How is it modified for unsaturated flow conditions in soils?			6	2	3, 4
b)	What is Gardner's exponential relationship for hydraulic conductivity? Write the equation and explain the significance of its parameters.			6	2	3, 4
c)	Discuss the importance of numerical modelling in unsaturated soil flow analysis. Mention any two commonly used numerical techniques or software tools.			6	2	3, 4
Q. 3	Attempt any two of the following			12		
a)	Write the extended Mohr-Coulomb equation for unsaturated soils. Define each term and explain the physical meaning of the additional suction-related parameter.			6	3	3, 4
b)	What are the challenges or limitations in measuring shear strength parameters for unsaturated soils experimentally?			6	3	3, 4
c)	State the Mohr-Coulomb failure criterion for saturated soils. How is it extended to represent the behavior of unsaturated soils?			6	3	3, 4

Q. 4	Attempt any two of the following	12		
a)	A silty soil has the following drained (saturated) shear-strength parameters: $c'=10$ kPa, $\phi'=30$. In the field, the soil is unsaturated: the pore-air pressure u_a is atmospheric (take as 0), and the pore-water pressure $u_w = -60$ kPa (i.e., matric suction $u_a - u_w = 60$ kPa). The degree of saturation is such that $\chi=0.5$. On a prospective failure plane the net normal stress $(\sigma - u_a) = 100$ kPa. (a) Compute the shear strength τ_f on that plane. (b) If the same soil were fully saturated (i.e. suction zero, $\chi(u_a - u_w)=0$), what would be its shear strength on the same plane?	6	4	4
b)	Explain the theoretical basis of shear strength in unsaturated soils. What additional stress variable(s) (compared to saturated soils) are considered and why?	6	4	3, 4
c)	Discuss how unsaturated soil behavior (suction, water retention characteristic, saturation degree) can affect lateral (active/passive/at-rest) earth pressures behind retaining structures. What modifications are necessary in classical earth-pressure theories to account for unsaturated conditions?	6	4	3, 4
Q. 5	Attempt any two of the following	12		
a)	Explain how the Soil-Water Retention Curve (SWRC) integrates into constitutive modeling of volume change. Why is hysteresis important for predicting deformation during wetting-drying cycles?	6	5	4
b)	Describe the elastoplastic stress-strain behavior of an unsaturated soil using the LC (Loading-Collapse) yield curve. How do drying and wetting paths influence the position of the yield surface?	6	5	4
c)	Explain the role of matric suction and net normal stress as independent stress state variables in unsaturated soil mechanics. Discuss the limitations of Bishop's effective stress concept.	6	5	4