Ref. No.: Ex/CE/5/T/506B/2025

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER EXAM 2025

SUBJECT: ADVANCED SOIL MECHANICS

Time: Three hours **Full Marks: 100**

PART - I

Marks : 50

Use separate answerscript for each part.

Answer any TWO from the following.

No. of Questions		Marks
Q.1.a)	Which type of triaxial test do you relate with unconfined compression test? Explain giving neat sketches.	5
Q.1.b)	Explain in detail the triaxial test of Q1(a) mentioning various stages and showing corresponding graphs. Show also the total and effective stress envelopes.	7
Q.1(c)	A normally consolidated clay specimen ($\varphi = 31^0$) was consolidated under a chamber-confining pressure of 132 kN/m^2. Failure of the specimen was caused by an added axial stress of 158.1 kN/m^2 in an undrained condition. Determine φ_{CU}, A_f and the pore water pressure in the specimen at failure.	13
2.(a)	State and explain how to determine the principal stresses from a given stress path.	5
2.(b)	Is there any difference between total shear stress (q) and effective shear stress (q$'$) with regard to the p-q diagram? Explain giving the analytical expressions.	5
2.(c)	For a saturated clay soil, the following are the results of some consolidated, drained triaxial test at failure:	15

Test no.	p' (kN/m^2)	q' (kN/m^2)
1.	420	179.2
2.	630	255.5
3.	770	308.0
4.	1260	467.0

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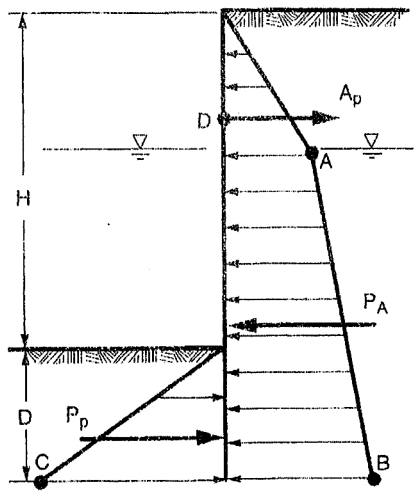
Answer any TWO from the following.

No. of Questions		Marks
	Draw a p' vs. q' diagram and from that determine c and φ for the soil.	
3.(a)	What is anchored bulk head? Explain any one of the method of design of anchored sheet pile wall with a neat sketch.	10
3.(b)	While designing a sheet pile wall as shown below in Fig., it was found that the soil behind and in front of the sheet pile wall was uniform sand with a friction angle $\varphi' = 33^0$, buoyant unit weight $\gamma_b = 10.25$ kN/m^3 and above the ground water table, the total unit weight $\gamma_t = 19.2$ kN/m^3. The sheet pile wall had H = 9.0 m and D = 6 m. The water level in front of the wall was at the same elevation as the groundwater table which was located 1.5 m below the ground surface and the tieback anchor was located 1.2 m below the ground surface. Calculate the factor of safety for toe kick-out and the tie back anchor force. In the analysis, neglect wall friction. Assume any other data not provided.	15



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BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER EXAMINATION– 2025

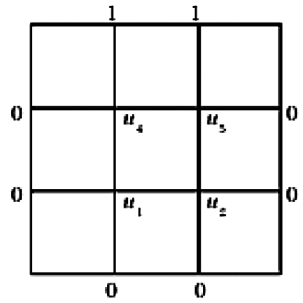
ADVANCED SOIL MECHANICS (PART II)

TIME: Three Hours | FULL MARKS: 100 (Part I:50+Part II: 50)

PART II (50 Marks)

Answer question no. 1 and any three from the rest

Assume any data if needed, reasonably

1.	Write short note on : (i) Vertical Sand Drains, (ii) Octahedral Shear Stress Theory, (iii) Compatibility Condition, (iv) Plane Stress Condition, and (v) Stress Invariants.	**(5×4=20)**
2	Prove that: 'if the stress vectors acting on three mutually perpendicular planes passing through a point are known, we can determine the stress vector acting on any other arbitrary plane at that point'.	**(10)**
3.	The state of stress at a point is characterised by the components: σ_{xx}= 100 MPa, σ_{yy}= = – 40 MPa, σ_{zz}= = 80 MPa, τ_{xy}= = τ_{xz} = τ_{yz} = 0 Determine the principal stresses and the associated planes, maximum shear stresses and their associated normal stresses.	**(10)**
4.	From Terzaghi's one dimensional consolidation equation prove that the excess pore water pressure (u) can be expressed as: $u = \sum_{n=1}^{n=\infty} \left(\frac{1}{H} \int_0^{2H} u_i \sin \frac{n\pi z}{2H} dz \right) \sin \frac{n\pi z}{2H} \exp\left(\frac{-n^2 \pi^2 T_v}{4} \right)$	**(10)**
5.	 Solve the Laplace Equation: $\nabla^2 u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ in the domain of the above Figure.	**(10)**