BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER EXAM 2024

SUBJECT: ADVANCED SOIL MECHANICS

Time : 3 Hours (50 Marks for each Part) Use separate answer script for each Part **Full Marks : 100**

PART – I (50 Marks)

Answer question no. 1 and any three from the rest

Assume any data if needed, reasonably

1. (a) Define the term "state of stress" at a point. **(2)**

(b) Write down the strain – displacement relation in Cartesian coordinate system **(3)**

2 (a) 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)**

(b) Differentiate between plane stress and plane strain problems with suitable examples. **(5)**

3. (a) Describe maximum shear stress theory and octahedral shear stress theory. **(5)**

(b) How does the projection of the yield surface in deviatoric plane looks like for octahedral shear stress theory? Prove it. **(10)**

4. (a) Focusing on design guidelines, write a short note on vertical sand drains. **(5)**

(b) From Terzaghi's one dimensional consolidation equation prove that the excess pore water pressure (u) can be expressed as: **(10)**

$$u = \sum_{n=1}^{n=\infty} \left(\frac{1}{H} \int_0^{2H} u_i \sin \frac{n\pi z}{2H} dz \right) \sin \frac{n\pi z}{2H} \exp\left(\frac{-n^2 \pi^2 T_v}{4} \right)$$

5. State of stress at a point is characterized by the following matrix **(15)**

$$\sigma = \begin{bmatrix} 18 & 0 & 24 \\ 0 & 2 & 0 \\ 24 & 0 & 32 \end{bmatrix} \text{kPa}$$

find stress invariants, characteristic equation, principal stresses and the principal plane associated with the maximum principal stress.

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PART - II (50 Marks)

Answer any TWO from the following.

No. of Questions		Marks
Q.1a)	State and explain stress path giving a neat sketch.	5
Q.1b)	Deduce the expression for K and draw the various K-lines. Explain K_0 and K_f lines giving neat sketches wherever necessary.	10
Q.1c)	CU triaxial tests conducted on specimens of a saturated clay soil gave the following results:	10

Cell Pressure σ_3 (kN/m^2)	Additional axial stress ($\sigma_1 - \sigma_3$) or deviator stress at failure (kN/m^2)	Pore water pressure, u at failure (kN/m^2)
150	102	80
300	200	164
450	304	264
600	405	325

	Determine the effective stress strength parameters c' and φ' by the Mohr circle method and the stress point method.	12
Q.2a)	Explain the various types of triaxial tests giving suitable sketches of the failure envelopes wherever necessary.	

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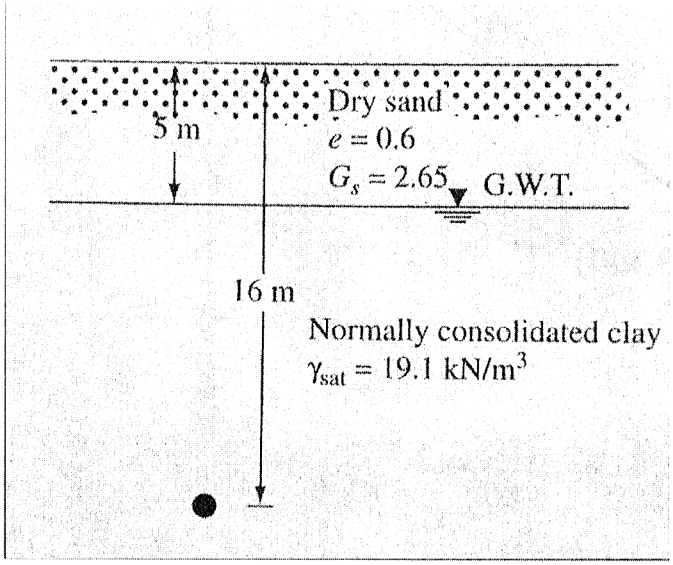
Answer any TWO from the following.

No. of Questions		Marks
Q.2b)	 A specimen of clay was collected from the field from a depth of 16 m (as shown above). A consolidated undrained triaxial test yielded the following results: $\varphi = 30^0$, $A_f = 0.8$. Estimate the undrained shear strength q_u of the clay.	13
Q.3a)	Deduce the expressions for Skempton's pore pressure parameters clearly mentioning their values for common types of soils.	12
Q.3b)	In a triaxial test, a soil sample was consolidated under a cell pressure of 700kN/m^2 and a back pressure of 350kN/m^2. Thereafter, with drainage not allowed, the cell pressure was raised to 800kN/m^2 resulting in the increased pore water pressure reading of 445 kN/m^2. The axial load was then increased to give a deviator stress of 575kN/m^2	13

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PART - II (50 Marks)

Answer any TWO from the following.

No. of Questions		Marks
	(while the cell pressure remained at 800kN/m^2) and a pore pressure reading of 640kN/m^2. Calculate the pore pressure coefficients B and A.	