Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - VII EXAMINATION - WINTER 2025

Subject Code: 3170620 **Date: 01-12-2025**

Subject Name: Computational Geotechnics

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define Successive Over Relaxation (SOR) method and explain the role of relaxation factor.	**03**
	(b)	Compare Bisection method and Successive Approximation method.	**04**
	(c)	Using Gauss–Seidel method, perform three iterations to solve the following system of equations: $8x - y + 2z = 20$ $2x + 6y - z = -12$. $x - y + 7z = 15$ Start with initial guess (0,0,0)	**07**
Q.2	**(a)**	Explain the difference between initial value problems (IVP) and boundary value problems (BVP) with appropriate applications in geotechnical engineering.	**03**
	(b)	Explain Bisection method with suitable example.	**04**
	(c)	Write down steps of forth order Runge Kutta method with suitable example.	**07**
		OR	
	(c)	Explain Second order Runge Kutta method with suitable example.	**07**
Q.3	**(a)**	Define “contact forces” in Discrete Element Modelling (DEM). Mention their significance in simulating granular materials.	**03**
	(b)	Explain Modified Mohr Coulomb failure theory for shear strength of soil with detailed strength envelop.	**04**
	(c)	Write a detailed note on Frictional 1-D plasticity models and explain how they help in understanding the stress–strain behaviour of soils.	**07**
		OR	
	(a)	Explain the need for constitutive modelling in soil mechanics.	**03**
	(b)	Enlist the assumption made in the theory of 1-D consolidation.	**04**
	(c)	Write detail note on Tri-axial test with neat sketch.	**07**
Q.4	**(a)**	Discuss the engineering relevance of yield surfaces in geotechnical constitutive models.	**03**

	(b)	Explain compression index (Cc) and Swelling index (Cs).	**04**
	(c)	Explain the Huber–von Mises failure criterion and state its limitations for geomaterials.	**07**
		OR	
	(a)	List the major assumptions used in Cam Clay constitutive modelling.	**03**
	(b)	Explain how the Lade–Duncan criterion accounts for stress invariants in predicting earth pressure.	**04**
	(c)	Explain the role of initial boundary value problems (IBVP) in modelling consolidation and slope stability.	**07**
Q.5	**(a)**	Define seepage velocity and hydraulic gradient. Explain their role in modelling flow through porous media.	**03**
	(b)	Discuss the physical meaning and laboratory determination of coefficient of consolidation (Cv).	**04**
	(c)	Explain consolidation mechanism using concept of spring analogy theory.	**07**
		OR	
	(a)	What are ordinary differential equations (ODE) and partial differential equations (PDE)? Give one geotechnical example for each.	**03**
	(b)	Explain the numerical modelling steps for 1-D consolidation using FDM,.	**04**
	(c)	Write a comprehensive note on flow through porous media, covering governing equations, assumptions, and numerical modelling approaches.	**07**

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