Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170513 Date:01-12-2023

Subject Name: Process Modelling, Simulation and Optimization

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)**	Explain concavity with examples.	**03**
	(b)	Describe briefly the fundamental laws used in mathematical models of chemical engineering systems.	**04**
	(c)	A tank contains 10 lit. of fresh water at time (t = 0), brine having a concentration of 10 kg/m3 of salt is feed into the tank at a rate of 0.5 lit/min. The mixture is kept uniform by mixing. The output from the tank is 0.4 lit/min. Evaluate the volume of water in the tank when the concentration inside the tank is 25% of that of inlet.	**07**
Q.2	**(a)**	Differentiate between deterministic and stochastic models.	**03**
	(b)	Develop a batch reactor model.	**04**
	(c)	Use the simplex method to find the maximum value of $Z = 2x_1 - x_2 + 2x_3$ (Objective function) subject to the constraints $2x_1 + x_2 \leq 10$, $x_1 + 2x_2 - 2x_3 \leq 20$, $x_2 + 2x_3 \leq 5$, where $x_1 \geq 0, x_2 \geq 0,$ and $x_3 \geq 0$.	**07**
		OR	
	(c)	A firm produces two goods, x and y. Due to a government quota, the firm must produce subject to the constraint x + y = 42. The firm's cost functions is $c(x, y) = 8x^2 - xy + 12y^2$. Maximize the function using lagrangian method.	**07**
Q.3	**(a)**	Classify the methods to solve unconstrained multivariable problems.	**03**
	(b)	Discuss the optimization of pipe diameter.	**04**
	(c)	Give a detail classification of models.	**07**
		OR	
Q.3	**(a)**	Differentiate sequential modular approach and simultaneous modular approach.	**03**
	(b)	Explain the application of optimization in fitting vapor-liquid equilibrium data.	**04**
	(c)	Describe any one chemical process simulator and its salient features.	**07**
Q.4	**(a)**	Define: feasible region, global minimum, convex region.	**03**
	(b)	Explain Simplex algorithm for linear programming.	**04**
	(c)	Discuss the optimizing recovery of waster heat with suitable figure and equations.	**07**
		OR	
Q.4	**(a)**	Explain the penalty methods for solving nonlinear programming with constraints.	**03**
	(b)	Write short note on decomposition of networks.	**04**
	(c)	Explain mathematical modeling of ideal binary distillation column.	**07**

Q.5	**(a)**	State objective functions in terms of the adjustable variable for chemical reactor.	**03**
	(b)	Explain random search and grid search method for unconstrained multivariable optimization.	**04**
	(c)	Using the Kuhn-Tucker conditions minimize the $f(X) = X_1^2 - X_2$, Subject to $X_1 + X_2 = 6$. $X_1 - 1 \geq 0$. $X_1^2 + X_2^2 \leq 26$.	**07**

OR

Q.5	**(a)**	Compare linear and non linear model.	**03**
	(b)	Write a note on the transport equations used for modeling.	**04**
	(c)	What is a linear programming problem? State the linear programming in standard form and write down its application in chemical industries.	**07**

****