Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3170513 Date: 21/06/2023

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.**

Q.1	**(a)**	Explain the meaning of following terms for optimization: Feasible solution, feasible region, optimal solution.	**03**
	(b)	Describe the major obstacles to optimization problem.	**04**
	(c)	List the six general steps for the analysis and solution of optimization problem.	**07**
Q.2	**(a)**	Explain various applications of modelling and simulation.	**03**
	(b)	A box with a square base and open top is to hold 1000 cm^3. Find the dimensions that require the least material (assume uniform thickness of material) to construct the box.	**04**
	(c)	Discuss the optimizing recovery of waste heat with suitable figure and equations.	**07**
		OR	
	(c)	Explain the features of Basic Tearing Algorithm.	**07**
Q.3	**(a)**	Explain equation solving approach in brief.	**03**
	(b)	Explain white box model.	**04**
	(c)	Develop batch reactor model.	**07**
		OR	
Q.3	**(a)**	Explain the importance of degree of freedom in model building.	**03**
	(b)	Differentiate between steady state and dynamic simulation.	**04**
	(c)	What is sequential modular approach in simulation? Explain the step with diagram.	**07**
Q.4	**(a)**	Explain the uses of mathematical models.	**03**
	(b)	Explain the penalty methods for solving nonlinear programming with constraints.	**04**
	(c)	Develop the equations for the series of isothermal, variable holdup CSTRs. List all the assumptions with their justifications.	**07**
		OR	
Q.4	**(a)**	Explain simplex search method.	**03**
	(b)	Determine positive-definiteness of a function f(x) $= 2x_1^2 - 3x_1x_2 + 2x_2^2$.	**04**
	(c)	Explain in brief how one-dimensional search is applied in a multidimensional problem.	**07**

Q.5 **(a)** Explain Lagrange multiplier method. **03**

(b) Explain the necessary and sufficient conditions for an extremum of an unconstrained function. **04**

(c) Minimize function f(x) =$x^4 - x + 1$ using Newton's method for starting point of x = 3 show five iterations. **07**

OR

Q.5 **(a)** Minimize the quadratic function f(x) = $x^2 - x$ using finite difference newton method start with x = 3 and h = 0.001. **03**

(b) Write a short note on decomposition of networks. **04**

(c) Solve the following linear programming problem using simplex method **07**

Maximize Z = $6x_1 + 5x_2$

Subject to $x_1 + x_2 \leq 5$

$3x_1 + 2x_2 \leq 12$

$x_1, x_2 \geq 0$