Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII(NEW) EXAMINATION – SUMMER 2019

Subject Code: 2180503 **Date: 17/05/2019**

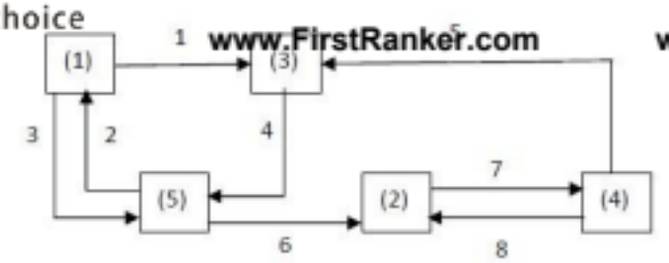
Subject Name: Process Modeling, Simulation & Optimization

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.**

Q.1	**(a)**	List out the important model building steps for a process.	**03**
	(b)	List out various professional simulator and explain features of any one in detail.	**04**
	(c)	Explain scope and hierarchy of optimization.	**07**
Q.2	**(a)**	Compare lumped parameter model and distributed parameter model.	**03**
	(b)	Write a note on the transport equations used for modeling.	**04**
	(c)	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.	**07**
		OR	
	(c)	What are the applications of optimization in chemical process and plants? Explain any one in detail with example.	**07**
Q.3	**(a)**	Explain the meaning of following terms for optimization: feasible solution, feasible region and optimum solution.	**03**
	(b)	Explain any one tearing algorithm with all the necessary steps.	**04**
	(c)	What is Hessian matrix? Write down its application in optimization. Determine whether the following function is convex or concave: $f(x) = 4x_1^2 + 3x_2^2 + 5x_3^2 + 6x_1x_2 + x_1x_3 - 2x_2 + 15$	**07**
		OR	
Q.3	**(a)**	Determine the optimum L/D ratio for a cylinder storage vessel. Also list the necessary assumptions.	**03**
	(b)	Differentiate between steady state and dynamic simulation.	**04**
	(c)	Minimize $f(x) = x^4 - x + 1$ using Newton's method for a starting point of x=0.6 (Show 3 iterations, use four decimal point accuracy).	**07**
Q.4	**(a)**	Differentiate sequential modular approach and simultaneous modular approach.	**03**
	(b)	A chemical process is represented by following set of equations; $f_1(x_3, x_4) = 0;$ $f_2(x_5, x_2) = 0;$ $f_3(x_6) = 0;$ $f_4(x_6, x_1) = 0;$ $f_5(x_3, x_2) = 0;$ $f_6(x_4, x_5, x_1) = 0;$ Determine associated matrix and the diagraph of the process.	**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 the term partitioning and tearing with respect to process simulation.	**03**
	(b)	Develop a signal flow graph for the diagraph given below:	**04**



(c) Explain: black-box model, white box model, gray model. **07**

Q.5 **(a)** Minimize the quadratic function f(x) = x^2 – x by Secant method. Use the range of -3 to +3. **03**

(b) Explain the application of optimization in fitting vapor-liquid equilibrium data. **04**

(c) Find the maximum of following function using Lagrangian multipliers; $y = 10x_1^2 - 4x_1x_2 + 3x_2^2 + 5x_2x_3$ sunject to **07**

$x_1 + 2x_2 \leq 3$

$x_2 - x_3 \geq 2$

$x_1 \geq 1$

OR

Q.5 **(a)** List out various region elimination methods for optimization. Also explain limitations of region elimination methods. **03**

(b) Discuss the optimization of pipe diameter. **04**

(c) Minimize following function using Simplex method; **07**

$Z = 3x_1 + 5x_2$ subject to

$x_1 \leq 4;$

$2x_2 \leq 12;$

$3x_1 + 2x_2 \leq 18;$

$x_1, x_2 \geq 0$

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