Seat No.: _____  Enrolment No. 

# GUJARAT TECHNOLOGICAL UNIVERSITY

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

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

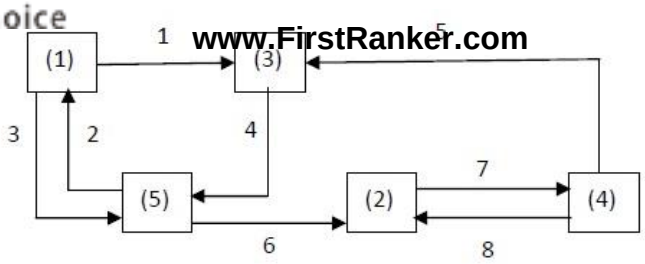
**Subject Name: Process Modeling, Simulation & Optimization**

**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

$x_1 \leq 4;$

$2x_2 \leq 12;$

$3x_1 + 2x_2 \leq 18;$

$x_1, x_2 \geq 0$

**********