

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VIII (NEW) EXAMINATION – SUMMER 2021****Subject Code:2180503****Date:06/08/2021****Subject Name:Process Modeling, Simulation & Optimization****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

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|--|--------------|
| Q.1 (a) List the applications of optimization in chemical engineering. | 03 |
| (b) Describe the major obstacles in solving optimization problems. | 04 |
| (c) Write the general procedure to solve optimization problems. | 07 |
| Q.2 (a) Determine whether the function is convex or concave:
$f = 2x_1^2 + 2x_1x_2 + 1.5x_2^2 + 7x_1 + 8x_2 + 24$ | 03 |
| (b) Determine and classify the types of extreme points of the function:
$f = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6.$ | 04 |
| (c) Explain the steps for finding the optimum L/D ratio for a pressurized cylindrical storage vessel. List all the variables and the important assumptions. | 07 |
| OR | |
| (c) Fit the following set of data to the equation $y = ae^{bx}$, a & b being constants. | 07 |

x	2.3	3.1	4.0	4.9	5.9	7.2
y	33	39.1	50.3	67.2	85.6	125

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| Q.3 (a) Explain the importance of degree of freedom in model building. | 03 |
| (b) List the fundamental laws used in chemical system modeling. | 04 |
| (c) Explain mathematical modelling of ideal binary distillation column. | 07 |
| OR | |
| Q.3 (a) Develop a model for a series of isothermal, variable hold-up CSTRs in which a first order reaction $A \rightarrow B$ is taking place. State the assumptions clearly. | 07 |
| (b) Differentiate between: <ol style="list-style-type: none"> i. Deterministic and stochastic process ii. Black box model, grey box model and white box model with proper example. | 07 |
| Q.4 (a) Explain Random search method and its significance. | 03 |

(b) Explain the Lagrange multiplier method and the Kuhn Tucker condition. **04**

(c) Solve the following Linear Programming Problem. **07**

$$\text{Maximize } Z = 6x_1 + 8x_2$$

subject to:

$$5x_1 + 10x_2 \leq 60,$$

$$4x_1 + 4x_2 \leq 40$$

$$x_1, x_2 \geq 0$$

OR

Q.4 (a) Minimize the quadratic function: $f(x) = x^2 - x$ using quasi-newton method. **03**

(b) Minimize the function $f = 4x_1^2 + x_2^2 - 2x_1x_2$ using Newton's method. Take starting point [1, 1]. **04**

(c) Minimize $f(x) = 4x_1^2 + 5x_2^2$ subject to $2x_1 + 3x_2 = 6$ using Lagrange multiplier method. **07**

Q.5 (a) Explain (i) digraph and (ii) signal flow graph, with diagram. **03**

(b) Differentiate between modular approach and equation solving approach in simulation. **04**

(c) Explain any one tearing algorithm with all the necessary steps. **07**

OR

Q.5 (a) Write a short note on decomposition of networks. **03**

(b) Differentiate between sequential modular approach and simultaneous modular approach in simulation. **04**

(c) List the process simulators used in chemical engineering. Discuss the salient features of process simulators. **07**
