

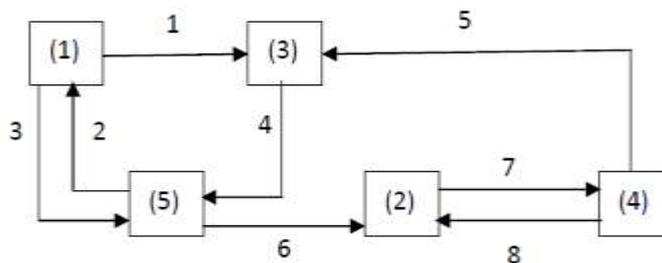
**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2021****Subject Code:3170513****Date:17/12/2021****Subject Name:Process Modelling, Simulation and Optimization****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

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) List the applications of optimization in chemical process engineering. **03**  
 (b) List out various professional process simulator and explain any one in brief. **04**  
 (c) Discuss essential feature of optimization problem. **07**
- Q.2** (a) Compare lumped parameter model and distributed parameter model. **03**  
 (b) A poster is to contain 300 cm<sup>2</sup> of printed matter with margins of 6cm at the top and bottom and 4cm at each side. Find the overall dimensions that minimize the total area of the poster. **04**  
 (c) Explain basic tearing algorithm. **07**

**OR**

- (c) For the digraph given below: **07**  
 i) Develop a signal flow graph.  
 ii) Find the streams that are to be teared (i.e. cut set) using Kehat and Shacham Algorithm.



- Q.3** (a) Define: simulation, optimization and modelling. **03**  
 (b) Explain partitioning with suitable example. **04**  
 (c) Describe classification of mathematical modelling based on state of the process. **07**

**OR**

- Q.3** (a) Define continuity of function and convexity. **03**  
 (b) Explain importance of modelling for simulation and optimization. **04**  
 (c) Explain Simultaneous modular approach in simulation. **07**
- Q.4** (a) Explain black box model. **03**  
 (b) Explain Lagrange multiplier and the Kuhn-Tucker conditions. **04**  
 (c) Determine the mathematical model for isothermal CSTR with constant hold-up. **07**

**OR**

- Q.4** (a) Show the advantages and disadvantages of Newton's method. **03**  
 (b) Determine the Hessian matrix of the function  $f(x) = 2x_1^2 - 3x_1x_2 + 2x_2^2$  **04**  
 (c) List the methods for unconstrained multivariable optimization problems. **07**  
 Explain any one in brief.

- Q.5 (a)** Minimize the function  $f(x) = x^2 - x$  using quadratic interpolation three point bracketing the minimum (-1.7,-0.1, 1.5) are used to start the search for the minimum of  $f(x)$ . **03**
- (b)** List the various equations of chemical kinetics used in process modelling. **04**
- (c)** Minimize function  $f(x) = x^4 - x + 1$  using Newton's method for starting point  $x=3$  show five iterations. **07**

**OR**

- Q.5 (a)** Minimize the quadratic function  $f(x) = x^2 - x$  using quasi Newton method start with  $x = -3$  and  $x = 3$ . **03**
- (b)** Discuss the degree of freedom analysis with suitable example. **04**
- (c)** Solve the following linear programming problem using simplex method **07**
- Maximize  $Z = 12 x_1 + 16 x_2$   
Subject to  $10 x_1 + 20 x_2 \leq 120$   
 $8 x_1 + 8 x_2 \leq 80$   
 $x_1, x_2 \geq 0$