B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E.   **Semester: V**
Branch: Chemical Engineering   **Duration: 3 hrs.**
Course Code: 19CH5DELB2   **Max Marks: 100**
Course: Optimization of Chemical Processes   **Date: 21.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Explain the scope and hierarchy of optimization. **06**

b) Illustrate the six steps used to solve optimization problems. **08**

c) Differentiate between payback period and net present value in detail. **06**

UNIT - II

2 a) **10**
$$f(x) = \frac{1}{17x} + 11x$$
$$f(x) = \ln(2x) + 5x^2$$

Check for continuity of the above functions and its first derivative.

b) Analyze for convexity and concavity of the following functions. **10**
$$f(x) = 3x^2 + 2x + 1$$
$$f(x) = -7x^3 + 2x^2 + 2$$
$$f(x,y) = 2x^2 + 3xy + 2y^2 + 3x - 2y + 5$$

UNIT - III

3 a) Solve the following constrained optimization problem applying Simplex method. **10**

$$Maximize \quad 10x_1 + 15x_2 + 20x_3$$
$$Subject \ to$$
$$2x_1 + 4x_2 + 6x_3 \leq 24$$
$$3x_1 + 9x_2 + 6x_3 \leq 30$$
$$x_1, x_2 \ and \ x_3 \geq 0$$

b) Solve the following constrained optimization problem. **10**
$$Minimize \quad 3x_1 + 2.5x_2$$
$$Subject \ to$$
$$2x_1 + 4x_2 \geq 40$$
$$3x_1 + 2x_2 \geq 50$$
$$x_1, x_2 \geq 0$$

UNIT - IV

4 a) Develop the objective function and constrained equations for optimal design and operation of a conventional staged distillation column. **10**

	b)	Find optimal number of stages of multi-effect evaporator for minimum overall cost.	**10**

<div align="center">OR</div>

5	a)	What are the inequality constraints in liquid-liquid extraction column?	**08**
	b)	Develop the objective function of the optimal recovery of waste heat and find the optimal temperature working fluid.	**12**

<div align="center">**UNIT-V**</div>

6	a)	Illustrate the effect of any five-factors considered for optimal design of gas transmission network.	**05**
	b)	Find the optimal inter-stage pressure of a gas compression system for minimum work.	**10**
	c)	Illustrate the effect of any five-factors considered for optimal design of a gas transmission network.	**05**

<div align="center">**OR**</div>

7	a)	Explain the significance of water production per filter run using the Letterman relation in economic operation of a fixed-bed filter.	**08**
	b)	Derive an energy balance equation applied for optimal design of an ammonia reactor and list the assumptions made.	**12**

<div align="center">******</div>