BIRLA INSTRITUTE OF TECHNOLOGY & SCIENCE, PILANI, PILANI CAMPUS
DEPARTMENT OF CHEMICAL ENGINEERING
First Semester 2022-23
CHE G558: Chemical Process Optimization
Comprehensive Examination (Open Classnotes)

Maximum Marks: 40 **Date: 20.12.2022** **Time: 180 minutes**

Note: All part of a question should be answered together and in sequence. Programmable calculators are not allowed.

1. (8 Marks). A manufacturer produces two types of models M1 and M2. Each M1 model requires 4 hours of grinding and 2 hours of polishing, where as M2 model requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishers. Each grinder works for 40 hours a week and each polisher works for 60 hours a week. Profit on M1 is Rs. 3 per unit and profit on M2 is Rs. 4 per unit. whatever is produced in a week is sold in the market. How should the manufacturer allocate his production capacity to two types of models so that the profit is maximum in a week?

a) Formulate the optimization problem.
b) Solve the above problem graphically.
c) Show how can you solve this problem using **Excel Solver**. Indicate the formulae to be used in specific cells.

2. (8 Marks) Solve the following LPP using simplex method:

Maximize $Z = 3x_1 + 5x_2$
Subject to
$3x_1 + 2x_2 <= 18$
$x_1 <= 4$
$x_2 <= 6$
$x_1 \geq 0, x_2 \geq 0.$

3. (8 Marks) Solve the following Quadratic Programming Problem (QPP) using modified simplex method.

Maximize: $f(x) = 8x_1 + 2x_2 + x_3 - x_1^2$

Subject to the constraints

$$x_1 + 3x_2 + 2x_3 \leq 12$$

$$x_1, x_2, x_3 \geq 0$$

4. (8 Marks) Use the KKT conditions to solve the NLP problem:

Maximize $f(x) = x_1 + 2x_2 - x_2^3$
Subject to
$x_1 + x_2 <= 1$
$x_1, x_2 >= 0$

5. (a) (4 Marks) For the unconstrained optimization problem:

Minimize $f(x) = x_1^2 + x_1x_2 + x_2^2 + 3x_1$.

Find the minimum (or minima) analytically. Are they global or relative minima?

(b) (4 Marks) Determine the nature of the stationary points of

$$f(x, y) = x^3 + y^2 - 3x - 6y - 1.$$

~ ALL THE BEST ~