Department of Chemical Engineering, Indian Institute of Technology Delhi
CHL774: Process Optimization
Semester I, 2008-2009

Major

Date: 22/11/08 | Closed Book & Closed Notes | Marks:40

Note:

1. Do not answer a question in more than one place. If the answer to a question is given at different places, only the first continuous attempt will be evaluated.
2. Show all the intermediate steps of the methods employed for the solution of the problems.
3. Supplementary answer-sheets will not be provided.

1. [8 Marks] Find optimal solution to transportation problem with four supply points and three demand station given in the following table

	Costs			Supply
	18	20	28	3
	12	22	20	5
	14	16	12	4
	15	12	32	6
Demand	4	8	6	

2. [8 Marks] A duct system having four sections is designed for a total pressure drop of 600 Pa. Ducts costs for various pressure drops in the sections are given in the following Table. Determine minimum cost and corresponding pressure drops. Duct flow requirements states that there should be a pressure drop in each section.

Section	Cost (in Rupees)		
	ΔP = 100 Pa	ΔP = 200 Pa	ΔP = 300 Pa
1	2350	2150	2010
2	1900	1720	1610
3	1410	1320	1180
4	990	910	840

3. [8 Marks] Determine the first Gomory cut for the following integer programming problem. Write the Gomory constraint using original variables

$$\begin{aligned} &\textit{Maximize} && x_1 + x_2 \\ &\textit{Subject to} && 2x_1 - x_2 \le 5 \\ & && x_1 + 2x_2 \le 3 \\ & && x_1, x_2 \ge 0 \text{ and integer} \end{aligned}$$

4. [8 Marks] Write KKT conditions for the following problem and solve to find at least one stationary point. Also check the second order positive-definiteness condition for the stationary point.

$$\begin{aligned} &\textit{Minmize}: \ (x_1 - 2)^2 + (x_2 - 1)^2 \\ &\textit{subject to}: \frac{x_1^2}{4} + x_2 \le 1 \\ &\qquad -x_1 + 2x_2 \ge 1 \end{aligned}$$

5. [8 marks] Convert the following polynomial problem into a linear 0-1 program and the solve it using Implicit enumeration

$$\begin{aligned} &\textit{Maximize}: \ 3x_1^2 x_2 x_3^3 \\ &\textit{subject to}: 4x_1 + 7x_2 x_3 \le 12 \\ &\qquad x_1, x_2 \ \textit{are} \ 0-1 \ \text{variable} \end{aligned}$$