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Thapar Institute of Engineering & Technology, Patiala

School of Mathematics

Mid Semester Examination (September 24, 2018)

Course Name: Optimization Techniques | M. Marks: 30
Course Code: UMA-031 | Time: 2 Hrs
Course Coordinator: Dr. Mahesh Kumar Sharma, Dr. Meenakshi Rana

NOTE : All questions are compulsory and preferably attempt them in the given sequence only.

1. (a) Solve the following LPP using Two-Phase method **(5)**
Minimization $z = x_1 + x_2 + x_3$ subject to

$$x_1 - 3x_2 + 4x_3 = 5, \quad x_1 - 2x_2 \leq 3, \quad 2x_2 - x_3 \geq 4 \quad\quad x_1, x_2 \geq 0 \text{ and } x_3\text{-unrestricted.}$$

(b) A patient in a hospital is required to have at least 84 units of vitamins A and 120 units of vitamin B each day. To meet the requirement of desired vitamins the patient consume two foods M and N. Each gram of food M contains 10 units of vitamin A and 8 units of vitamin B, and each gram of food N contains 2 units of vitamin A and 4 units of vitamin B. Now suppose that both foods M and N contain an undesirable substance C. The units of undesirable substance C in foods M and N are 3 and 1 units per gram respectively. How many grams of foods M and N should be mixed to meet the minimum daily requirements, at the same time minimizing the intake of substance C? Formulate the above as an LPP model. **(5)**

2. (a) State and prove Fundamental Theorem of Linear Programming Problem (LPP) for a maximization LPP. **(3)**

(b) Consider the following constraints of an LPP

$$x_1 + 4x_2 + x_3 = 8, \quad x_1 + 2x_2 + x_4 = 4, \quad\quad x_1, x_2, x_3, x_4 \geq 0$$

(i) Identify all Basic Feasible Solutions. **(3)**
(ii) Construct the simplex table for the solution $(4, 0, 4, 0)$ to above problem, assuming the objective function associated with above constraints is Minimization $z = 2x_1 - x_2$. (Do not use row-operations). **(4)**

3. (a) Solve the following LPP by Dual simplex method **(4)**

$$\text{Maximization } z = -x_1 \text{ subject to } x_1 - x_2 \geq 3, \quad -x_1 + x_2 \leq 4, \quad\quad x_1, x_2 \geq 0.$$

(b) Consider the problem
Maximization $z = 2x_1 + x_2 - x_3$ subject to

$$x_1 + 2x_2 + x_3 \leq 8, \quad -x_1 + x_2 - 2x_3 \leq 4, \quad x_1, x_2, x_3 \geq 0.$$

The optimum table of the above LPP is given as:

B.V.	x_1	x_2	x_3	s_1	s_2	Solution
$z_j - c_j \rightarrow$	0	3	3	2	0	16
x_1	1	2	1	1	0	8
s_2	0	3	-1	1	1	12

(i) Write the dual of the problem and find the optimal dual solutions from the optimal tableau given above. **(2)**
(ii) Find the new optimal solution if the coefficient of x_2 in the objective function is changed from 1 to 6. **(2)**
(iii) What will be the change in the optimal solution, if the constraint $x_2 + x_3 \geq 3$ is added to the current LPP. **(2)**