Cluster Innovation Centre, University of Delhi
B.Tech (Information Technology and Mathematical Innovations)
End Term Examination: 2019-2020, Semester- VI
Paper Code: 911610
VI.1: Linear Construction of Actions: Engineering through Linear Programming and Game Theory

Max Time: 2 Hours;   Max Marks: 75

Attempt any four questions, each question carries equal marks.

1. Greenthumb.com, a fertilizer company, wants to make two types of fertilizers: high-nitrogen and all-purpose fertilizers. There are two types of components needed to make these fertilizers. Component 1 consists of 60% nitrogen and 10% phosphorous and costs 20 cents per pound. Component 2 consists of 10% nitrogen and 40% phosphorous and costs 30 cents per pound. The company wants to produce 5000 25-pound bags of high-nitrogen fertilizer and 7000 25-pound bags of all- purpose fertilizer. Determine the optimal model for the company.

2. Solve the following problem using big-M method
$$\text{Maximize } z = 3x_1 + 4x_2$$
       subject to
$$2x_1 + 3x_2 \geq 8$$
$$5x_1 + 2x_2 \geq 12$$
$$x_1, x_2 \geq 0$$

3. Wild west produces two types of cowboy hat. A type 1 hat requires twice as much labor time as a Type 2. If all the available labor time is dedicated to Type 2 alone, the company can produce a total of 400 Type 2 hats a day. The respective market limits for the two types are 150 and 200 hats per day. The revenue is $8 per Type 1 hat and $5 per Type 2 hat. Determine the dual price of the production capacity (in terms of the Type 2 hat) and the range for which it is applicable and if the daily demand limit on the type 1 hat is decreased to 120, use the dual price to determine the corresponding effect on the optimal revenue.

4. Generate the dual simplex iterations for the following problem and trace the path of the algorithm on the graphical solution space

$$\text{Minimize } z = 3x_1 + 2x_2 + x_3$$

       subject to

$$3x_1 + x_2 + x_3 \geq 3$$
$$-3x_1 + 3x_2 + x_3 \geq 6$$
$$x_1 + x_2 + x_3 \leq 3$$

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

5. Red Bus Company operates buses between Delhi and Jaipur. A bus trip between these two cities takes 6 hours. A law requires that a driver rest for four or more hours between trips. A driver's workday consists of two trips: one from Delhi to Jaipur and one from Jaipur to Delhi. Table gives the departure times for the buses. Red's goal is to minimize the total downtime for all drivers. How should Red Bus assign crews to trips? Note: It is permissible for a driver's "day" to overlap midnight. For example, a Jaipur-based driver can be assigned to the Jaipur–Delhi 3 P.M. trip and the Delhi–Jaipur 6 A.M. trip.

Trip	Departure Time	Trip	Departure Time
Delhi 1	6 AM	Jaipur 1	5.30 AM
Delhi 2	7.30 AM	Jaipur 2	9 AM
Delhi 3	11.30 AM	Jaipur 3	3 PM
Delhi 4	7 PM	Jaipur 4	6.30 PM
Delhi 5	12.30 AM	Jaipur 5	12 Midnight

6. Three refineries with daily capacities of 6, 5 and 8 million gallons, respectively, supply three distribution areas with daily demands 4, 8 and 7 million gallon respectively. Gasoline is transported to three distribution areas through a network pipelines. The transportation cost is10 cents per 1000 gallons per pipeline mile. The table below gives the mileage between the refineries and the distribution areas. Refinery 1 is not connected to distribution area 3. Determine the optimum shipping schedule in the network.

		Distribution area		
		1	2	3
	1	12	18	-
Refinery	2	30	10	8
	3	20	25	12