

Cluster Innovation Centre, University of Delhi, Delhi-110007

Examination : End Semester Examination – May 2022
Name of the Course : B.Tech (Information Technology and Mathematical Innovations)
Name of the Paper : Linear Construction of Actions: Engineering through Linear Programming and Game Theory
Paper Code : 32861601
Semester : VI
Duration : 2 Hours+30 minutes
Maximum Marks : 40

Instructions:

This question paper contains five questions, out of which any four are to be attempted. Each question carries equal marks.

1. A Manufacturing Company has a contract to deliver 100, 250, 190, 140, 220, and 110 home windows over the next 6 months. Production cost (labor, material, and utilities) per window varies by period and is estimated to be \$50, \$45, \$55, \$48, \$52, and \$50 over the next 6 months. To take advantage of the fluctuations in manufacturing cost, Acme can produce more windows than needed in a given month and hold the extra units for delivery in later months. This will incur a storage cost at the rate of \$8 per window per month, assessed on end-of-month inventory. Develop a linear program to determine the optimum production schedule.
2. Best-ride airlines that operates seven days a week has the following time-table.

Flight No.	Delhi - Mumbai		Flight No.	Mumbai-Delhi	
	Departure	Arrival		Departure	Arrival
1	7.00 AM	8.00 AM	101	8.00 AM	9.00 AM
2	8.00 AM	9.00 AM	102	9.00 AM	10.00 AM
3	1.00 PM	2.00 PM	103	12.00 Noon	1.00 PM
4	6.00 PM	7.00 PM	104	5.00 PM	6.00 PM

Crews must have a minimum layover of 5 hours between flights. Obtain the pairing of flights that minimizes layover time away from home. For any given pairing, the crew will be based at

the city that results in the smaller layover. For each pair also mention the city where crew should be based.

4. Three electric power plants with capacities of 25, 40, and 30 million kWh supply electricity to three cities. The maximum demands at the three cities are estimated at 30, 35, and 25 million kWh. The price per million kWh at the three cities is given in Table below.

		City		
		1	2	3
Plant	1	\$600	\$700	\$400
	2	\$320	\$300	\$350
	3	\$500	\$480	\$450

During the month of August, there is a 20% increase in demand at each of the three cities, which can be met by purchasing electricity from another network at a premium rate of \$1000 per million kWh. The network is not linked to city 3, however. The utility company wishes to determine the most economical plan for the distribution and purchase of additional energy.

(a) Formulate the problem as a transportation model.

(b) Determine an initial optimal distribution plan for the utility company using penalty cost method.

5. UA and DU are devising their strategies for the 1994 national championship men's college basketball game. Assessing the strengths of their respective "benches," each coach comes up with three strategies for rotating the players during the game. The ability of each team to score 2-pointers, 3-pointers, and free throws is key to determining the final score of the game. The following table summarizes the net points UA will score per possession as a function of the different strategies available to each team:

	DU_1	DU_2	DU_3	DU_4
UA_1	3	-2	1	4
UA_2	2	3	-5	0

UA_3	-1	2	-2	2
UA_4	-3	-5	4	1

Develop a linear programming modal for UA and DU and explain the relationship between two modals.

6. Consider the following integer linear programming problem:

$$\text{Maximize } z = 7x_1 + 10x_2$$

$$\text{subject to } -x_1 + 3x_2 \leq 6$$

$$7x_1 + x_2 \leq 35$$

$$x_1, x_2 \geq 0 \text{ and integer}$$

the optimum Simplex LP tableau for this problem is given as

Basic	x_1	x_2	x_3	x_4	Solution
Z	0	0	$\frac{63}{22}$	$\frac{31}{22}$	$66\frac{1}{2}$
x_2	0	1	$\frac{7}{22}$	$\frac{1}{22}$	$3\frac{1}{2}$
x_1	1	0	$-\frac{1}{22}$	$\frac{3}{22}$	$4\frac{1}{2}$

Perform one iteration of Gomory's cutting plane method and explain that solution graphically.