Seat No. : ______________

AA-114

April-2023

Int. M.B.A., Sem.-VI

Operations Research

Time : 2:30 Hours] **[Max. Marks : 70**

Instructions : (1) Graphs and Statistical tables will be providing on request.

(2) Non-programable scientific calculator can be used.

1. Attempt the following :

   (a) Explain use of linear programming problem in detail. **4**

   (b) An electric company produces two products A and B. Products are produced and sold on a weekly basis. The weekly production cannot exceed 25 for product A and 35 for product B because of limited available facilities. The company employs total of 60 workers. Product A requires 2 man - weeks of labour, while B requires one man - week of labour. Profit margin on A is ₹ 60 and on B is ₹ 40. Formulate this problem as a Linear Programming Problem and solve graphically. **10**

2. Solve the following using appropriate version of simplex algorithm : (Any **TWO**) **14**

   (a) Minimize $Z = 5A + 3B$

   Subject to

   $2A + 4B \leq 12$

   $2A + 2B = 10$

   $5A + 2B \geq 10$

   $A, B \geq 0$

   (b) Maximize $Z = 30A + 40B + 35C$

   Subject to

   $3A + 4B + 2C \leq 90$

   $2A + B + 2C \leq 54$

   $A + 3B + 2C \leq 93$

   $A, B, C \geq 0$

(c) A company makes two kinds of leather belts: Belt A and Belt B. Belt A is a high - quality belt and Belt B is of lower quality. The respective profits are ₹ 4 and ₹ 3 per belt. The production of each type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 of these are available per day. There are only 700 buckles a day available for belt B. What should be the daily production of each type of belt ? Formulate this problem as an LP model and solve it using the simplex method.

3. Solve the following : **14**

A company makes three products: X, Y and Z out of three raw materials A, B and C. The raw material requirements are given below :

Raw Materials	**Number of Units of Raw Material Required to Produce one Unit of Product**		
	X	**Y**	**Z**
A	1	2	1
B	2	1	4
C	2	5	1

The unit profit contribution of the products : X, Y and Z is ₹ 40, ₹ 25 and ₹ 50, respectively. The number of units of raw material available are 36, 60 and 45 respectively.

(i) Determine the product mix that will maximize the profit.

(ii) Formulate the dual of the problem.

(iii) Also find solution of the dual from (i).

(iv) Examine the sensitivity of the optimal solution obtained in (i) for variation in profit contribution per unit and variation in the availability of resources.

4. (a) Give difference between transportation and transshipment problem. **4**

(b) Solve following : (Any **ONE**) **10**

(1) A company has factories at F1, F2 and F3 that supply product to warehouses at W1, W2 and W3. The weekly capacities of the factories are 200, 160 and 90 units, respectively. The weekly warehouse requirements are 180, 120 and 50 units, respectively. The unit shipping costs (in rupees) are as follows :

Factory	**Warehouse**			**Supply**
	W1	**W2**	**W3**	
F1	16	20	12	200
F2	14	8	18	160
F3	26	24	16	90
Demand	180	120	150	

Determine

(i) The optimal distribution for this company to minimize its total shipping cost.

(ii) If due to some reasons route F2 to W2 is closed down, then what is the change in the solution ?

(2) Consider the following transshipment problem with two sources and three destinations. The unit cost of transportation between different possible nodes is given in the following table. Find the optimal shipping plan such that the total cost is minimized.

Sources	**Destination**					**Supply**
	S1	**S2**	**D1**	**D2**	**D3**	
S1	0	3	12	4	12	800
S2	5	0	3	6	10	700
D1	8	10	0	4	20	–
D2	20	12	5	0	15	–
D3	8	10	30	8	0	–
Demand	–	–	**500**	**400**	**600**	

5. Solve following : (Any **TWO**) **14**

(a) An accounting firm has three new clients. Project leader will be assigned to the three clients. Based on the different backgrounds and experiences of the leaders, the various leader – client assignments differ in terms of projected completion times. The possible assignments and the estimated completion times in days are.

Project Leader	**Client**		
	1	**2**	**3**
Jackson	10	16	32
Ellis	14	22	40
Smith	22	24	34
Burton	14	18	36

Determine

(i) What is the optimal assignment ?

(ii) What is the minimum completion time ?

(iii) Which project leader remains unassigned ?

(b) A company has four sales territories, each of which must be assigned a sales representative. From past experience the firm's sales manager has estimated the annual sales volume ($ 1000s) for each sales representative in each sales territory. Find the territory assignments that will maximize sales.

Sales Representative	**Sales Territory**			
	A	**B**	**C**	**D**
Washington	44	80	52	60
Benson	60	56	40	72
Fredricks	36	60	48	48
Hodson	52	76	36	40

(c) A salesman wants to visit cities A, B, C, D and E. He does not want to visit any city twice before completing his tour of all the cities and wishes to return to the point of starting journey. Cost of going from one city to another (in rupees) is shown in the table given below. Find the least cost route.

	A	**B**	**C**	**D**	**E**
A	–	2	5	7	1
B	6	–	3	8	2
C	8	7	–	4	7
D	12	4	6	–	5
E	1	3	2	8	–