Seat No. : _____

AI-107

April-2025

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

Operations Research

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

Note : (1) Non - Programmable Scientific Calculator can be used.
(2) Graphs and Statistical Tables will be provided on request.
(3) Attempt new questions on new page.

1. Attempt the following : **14**
   (a) What is the Linear Programming Problem ? Explain this through its mathematical form.
   (b) The Crumb and Custard Bakery makes coffee cakes and Danish pastries in large pans. The main ingredients are flour and sugar. There are 25 pounds of flour and 16 pounds of sugar available, and the demand for coffee cakes is 5. Five pounds of flour and 2 pounds of sugar are required to make a pan of coffee cakes, and 5 pounds of flour and 4 pounds of sugar are required to make a pan of Danish. A pan of coffee cakes has a profit of $1, and a pan of Danish has a profit of $5. Determine the number of pans of cakes and Danish to produce each day so that profit will be maximized. Formulate above as a linear programming problem and solve it graphically.

2. Solve the following using appropriate version of simplex algorithm (any **two**) : **14**
   (a) Maximize $Z = 5A + 3B$
   Subject to
   $2A + B \leq 1$
   $A + 4B \geq 6$
   $A, B \geq 0.$
   (b) Maximize $Z = 2A + 5B$
   Subject to
   $A + 4B \leq 24$
   $3A + B \leq 21$
   $A + B \leq 9$
   $A, B \geq 0.$
   (c) A firm has 240, 370 and 180 kg of wood, plastic and steel respectively. The firm produces two products, A and B. Each unit of A requires 1, 3 and 2 kg of wood, plastic and steel respectively. The corresponding requirement for each unit of b is 3, 4 and 1 kg respectively. If A sells for ₹ 4 and B sells for ₹ 6 per unit, what product mix should the firm produce to have maximum gross income ? Formulate this as Linear Programming Problem and solve it.

3. Attempt the following (any **two**) : **14**

(a) Solve the following linear programming problem :

Maximize $Z = 3A + 5B$

Subject to

$A + B \leq 4$

$3A + 2B \leq 18$

$A, B \geq 0.$

If a new variable is included in the above problem with a profit of 7 and 2 and 4 as the coefficient of the first and the second constraints, respectively, find the solution to the new problem based on the optimal solution of the given problem.

(b) Solve the following linear programming problem using simplex method :

Maximize $Z = 20A + 80B$

Subject to

$4A + 6B \leq 90$

$8A + 6B \leq 100$

$A, B \geq 0$

If a new constraint $5A + 4B \leq 80$ is added to this model, find the solution to the new problem.

(c) Convert the primal problem into the dual problem and solve the dual problem.

Maximize $Z = 2A + B$

Subject to

$A + 2B \leq 10$

$A + B \leq 6$

$A - B \leq 2$

$A - 2B \leq 1$

$A, B \geq 0.$

4. Attempt the following (any **two**) : **14**

(a) Obtain an optimal solution for the following transportation problem :

Factory	**Warehouse**				**Factory Capacity**
	W1	**W2**	**W3**	**W4**	
F1	19	30	50	10	7
F2	70	30	40	60	9
F3	40	8	70	20	18
Warehouse Requirement	5	8	7	14	

(b) A multi-plant organization has three plants (A, B and C) and three market places (X, Y and Z). The items from the plants are transported to the market places through two intermediate finished goods warehouses, Wl and W2. The details on cost of transportation per unit for different combinations are summarized in the following table :

Find the optimal shipping plan such that total cost of transshipment is minimized.

Starting Nodes	**Terminal Nodes**					**Supply**
	X	**Y**	**Z**	**W1**	**W2**	
A	∞	∞	∞	25	40	400
B	∞	∞	∞	38	20	500
C	∞	∞	∞	40	25	600
W1	20	45	25	0	25	–
W2	30	20	40	40	0	–
Demand	300	700	500	–	–	

(c) A company has four warehouses and five stores. Cost of shipping one unit from the ith warehouse to jth store is as displayed in the following table :

Warehouse	**Store**					**Surplus**
	S1	**S2**	**S3**	**S4**	**S5**	
W1	9	12	10	10	6	150
W2	5	18	12	11	2	30
W3	10	–	7	3	20	120
W4	5	6	2	–	8	130
Requirement	80	60	20	210	80	

How should the company arrange to transport the units so that the transportation cost is minimized ?

5. Attempt the following (any **two**) : **14**

(a) A sales manager wishes to assign four sales territories to four sales persons. The salespersons differ in their sales acumen and consequently, the sales expected to be affected in each territory are different for each salesperson. The estimates of sales per month for each salesperson in each territory are given below :

Salesperson	**Estimated Monthly Sales (in crores of rupees) in territory**			
	I	**II**	**III**	**IV**
A	20	40	45	30
B	50	40	55	40
C	45	40	42	50
D	48	50	42	45

Suggest optimal assignment of the four salespersons to various territories and the total maximum monthly sales.

(b) A salesman wants to visit cities 1, 2, 3 and 4. He does not want to visit any city twice before completing the tour of all the cities and wishes to return to his home city, the starting station. Cost of going from one city to another in rupees is given in the following table :

From City	To City			
	1	**2**	**3**	**4**
1	–	30	80	50
2	40	–	140	30
3	40	50	–	20
4	70	80	130	–

Find the least cost route for the travelling salesman.

(c) The following information is available regarding four different jobs to be performed and about the clerks capable of performing the jobs :

Clerks	Jobs (Time taken in hours)			
	A	**B**	**C**	**D**
I	4	7	5	6
II	–	8	7	4
III	3	–	5	3
IV	6	6	4	2

Clerk II cannot be assigned to job A and clerk III cannot be assigned to job B. You are required to find out the optimal assignment schedule and the total time taken to perform the jobs.