



FD-618

M.A./M.Sc. 3rd Semester
Examination, Dec.-Jan., 2021-22

MATHEMATICS

Optional - A

Paper - IV

Operations Research - I

Time : Three Hours] [Maximum Marks : 80

[Minimum Pass Marks : 16

Note : Answer any **two** parts from each question. All questions carry equal marks.

Unit-I

1. (a) Solve the following linear programming problem by simplex method :

Maximize $Z_1 = 3x_1 + 2x_2 + 5x_3$

Subject to $x_1 + 2x_2 + x_3 \leq 430$

$3x_1 + 2x_3 \leq 460$

$x_1 + 4x_2 \leq 420$

$x_1, x_2, x_3 \geq 0$

(2)

(b) Apply the principle of duality to solve the linear programming problem :

$$\text{Maximize } Z_1 = 3x_1 - 2x_2$$

$$\text{Subject to } x_1 + x_2 \leq 5$$

$$x_1 \leq 4$$

$$1 \leq x_2 \leq 6 \text{ and } x_1, x_2 \geq 0$$

(c) A Steel company manufactures three products P_1, P_2, P_3 . Each product has to pass through two machines M_1 and M_2 . Each unit of P_1 requires 3 hours of M_1 and 2 hours of M_2 , each unit of P_2 requires 2 hours of M_1 and 5 hours of M_2 ; and each unit of P_3 requires 2 hours of M_1 and 3 hours of M_2 . The machines M_1 and M_2 are available for 30 hours and 40 hours respectively. The profit on each unit of products P_1, P_2 and P_3 is ₹ 4, ₹ 2 and ₹ 3 respectively. If all the manufactured products are sold, formulate the problem as an LPP to maximize the profit.

Unit-II

2. (a) Use Dual Simplex method to solve the following :

$$\text{Maximize } Z = -2x_1 - x_3$$

$$\text{Subject to } x_1 + x_2 - x_3 \geq 5$$

$$x_1 - 2x_2 + 4x_3 \geq 8$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

(3)

(b) Use Big-M method to solve the following :

$$\text{Maximize } Z = 3x_1 - x_2$$

$$\text{Subject to } 2x_1 + x_2 \geq 2$$

$$x_1 + 3x_2 \leq 3$$

$$x_2 \leq 4 \text{ and } x_1, x_2 \geq 0$$

(c) Write the dual of the following L.P. problem :

$$\text{Minimize } Z_1 = 3x_1 - 2x_2 + 4x_3$$

$$\text{Subject to } 3x_1 + 5x_2 + 4x_3 \geq 7$$

$$6x_1 + x_2 + 3x_3 \geq 4$$

$$7x_1 - 2x_2 - x_3 \leq 10$$

$$x_1 - 2x_2 + 5x_3 \geq 3$$

$$4x_1 + 7x_2 - 2x_3 \geq 2$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

Unit-III

3. (a) For the following L.P.P

$$\text{Minimize } Z = \lambda x_1 - \lambda x_2 - x_3 + x_4$$

$$\text{Subject to } 3x_1 - 3x_2 - x_3 + x_4 \geq 5$$

$$2x_1 - 2x_2 + x_3 - x_4 \leq 3$$

$$\text{and } x_1, x_2, x_3, x_4 \geq 0$$

find the range of λ over which the solution remain basic feasible and optimal.

(4)

- (b) An office equipment manufacturer procures two kinds of products, chairs and lamps. Production of either a chair or a lamp requires 1 hour of production capacity in the plant. The plant has a maximum capacity of 10 hours per week. The gross margin from the sale of a chair is ₹ 80 and ₹ 40 for that of a lamp. Formulate the problem as a goal programming problem if the goal of the firm is to earn a profit of ₹ 800 per week.
- (c) Explain the graphical solution to a general programming problem.

Unit-IV

4. (a) Solve the following transportation problem in which cell entries represent unit costs :

		To			Available
From	2	7	4	5	
	3	3	1	8	
	5	4	7	7	
	1	6	2	14	
Required	7	9	18	34	

(5)

- (b) Solve the minimal assignment problem whose effectiveness matrix is given by :

	1	2	3	4
I	2	3	4	5
II	4	5	6	7
III	7	8	9	8
IV	3	5	8	4

- (c) Prove that a necessary and sufficient condition for the existence of feasible solution of a transportation problem is

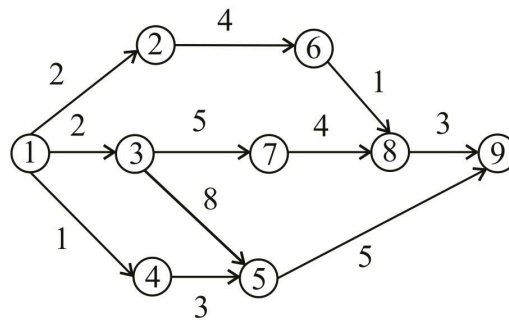
$$\sum a_i = \sum b_j \quad (i = 1, 2, \dots, m, j = 1, \dots, n)$$

Unit-V

5. (a) Define the following :
- (i) Merge event
 - (ii) Burst event
 - (iii) Total float
 - (iv) Free float

(6)

(b) Find the critical path and calculate the slack time for each event for the following PERT diagram :



(c) A project has the following time schedule :

Activity	Time in weeks
(1-2)	4
(1-3)	1
(2-4)	1
(3-4)	1
(3-5)	6
(4-9)	5
(5-6)	4
(5-7)	8
(6-8)	1
(7-8)	2
(8-9)	1
(8-10)	8
(9-10)	7

(7)

Construct PERT network and compute :

- (i) T_E and T_L for each event
 - (ii) Float for each activity
 - (iii) Critical path and its duration
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