

Time: 3 hours

Marks: 80

- Note:
- Question 1 is compulsory
 - Answer any 3 from the remaining 5 questions
 - Figures to the right indicate marks
 - Use of scientific calculator is allowed

- Q1 a) A diet for a sick person must contain 4000 units of vitamins, 50 units of minerals and 1400 calories. Two foods A and B are available at a cost of Rs 4 and Rs 3 respectively. If one unit of A contains 200 units of vitamins, 1 unit of minerals and 40 calories; and 1 unit of B contains 100 units of vitamins, 2 units of minerals and 40 calories; find by graphical method what combination of foods should be used at the least cost. [10]
- b) Following activity times (in days) are provided: [10]

Activity	t_o (Optimistic Time)	t_m (Most Likely Time)	t_p (Pessimistic Time)
1-3	1	3	5
1-2	3	4	5
3-5	4	5	6
2-4	3	5	7
4-5	5	6	13
5-6	4	7	10
4-6	6	8	10

- Draw the network, identify the critical path
- Compute the expected completion time and variance of the project
- What is the probability that the project will be completed within 20 days. (Given for SNV area under the normal curve from 0 to 1.64 = 0.4495)
- What due date has 90% chance of being met? (Given for SNV area under the normal curve from 0 to 1.28 = 0.3997)

- Q2 a) Solve using Two-phase simplex method [10]

$$\text{Minimize } Z = x_1 + x_2$$

subject to

$$2x_1 + x_2 \geq 4$$

$$x_1 + 7x_2 \geq 7$$

and

$$x_1, x_2 \geq 0$$

- Q2 b) A company has four different sales representatives who are to be assigned to 4 different state territories. The monthly sales increase estimated for each sales representative for different sales territories (in lakhs of Rs.) are shown in the following table. Suggest optimal assignment and the total maximum sales increase per month. [10]

Sales Representative	Territories			
	I	II	III	IV
A	200	150	170	220
B	160	120	150	140
C	190	195	190	200
D	180	175	160	190

- Q3 a) Five jobs 1, 2, 3, 4 and 5 are to be processed on 4 machines A, B, C and D in the order ABCD. Their processing times (in hours) are given in the table below. Determine the optimal sequence of jobs, minimum elapsed time and idle time for each machine [10]

Jobs	Machines			
	A	B	C	D
1	11	4	6	15
2	13	3	7	8
3	9	5	5	13
4	16	2	8	9
5	16	6	4	11

- b) The data collected in running a machine, the cost of which is Rs.60000 are given below. Determine the optimum period of replacement of the machine. [10]

	Year				
	1	2	3	4	5
Resale value (Rs.)	42000	30000	20400	14400	9650
Cost of spares (Rs.)	4000	4270	4880	5700	6800
Cost of labour (Rs.)	14000	16000	18000	21000	25000

[TURN OVER]

- Q4 a) Two firms are competing for business under conditions such that one firm's gain is another firm's loss. Firm A's payoff matrix is given below. Find the optimal strategies to be used by both players and the value of the game. [10]

		Firm B		
		No Advertising	Medium Advertising	Heavy Advertising
Firm A	No Advertising	10	5	-2
	Medium Advertising	13	12	15
	Heavy Advertising	16	14	10

- b) Solve using Simplex Method [10]

Maximize $Z = 3x_1 + 4x_2$

subject to

$$2x_1 + x_2 \leq 6$$

$$2x_1 + 3x_2 \leq 9$$

and

$$x_1, x_2 \geq 0$$

- Q5 a) A company has three plants and warehouses. The supply and demand in units and the corresponding transportation costs are given. If the solution is as given below in brackets, check if it is optimal [10]

		Warehouse				Supply
		I	II	III	IV	
Plants	A	5	10	4 (10)	5	10
	B	6 (20)	8	7	2 (5)	25
	C	4 (5)	2 (10)	5 (5)	7	20
Requirement		25	10	15	5	55

[10]

b) A project has 11 activities whose duration (in days) is given below

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7	7-8
Duration	2	8	10	6	3	3	7	5	2	8	3

- i) Draw the network
- ii) Identify the project completion time, critical activities and critical path
- iii) Determine the total, free and independent floats

[05]

Q6 a) i) Find the dual of the primal given below

$$\text{Maximize } Z = 3x_1 + 5x_2$$

subject to

$$2x_1 + 6x_2 \leq 50$$

$$3x_1 + 2x_2 \leq 35$$

$$5x_1 - 3x_2 \leq 10$$

$$x_2 \leq 20$$

and

$$x_1, x_2 \geq 0$$

ii) Define the term redundant constraints in the graphical method

[05]

b) Solve using Gomory's Cutting Plane Method

[10]

$$\text{Maximize } Z = 5x_1 + 7x_2$$

subject to

$$-2x_1 + 3x_2 \leq 6$$

$$6x_1 + x_2 \leq 30$$

and

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