Duration 3 hours **Total 100 marks**

N.B: (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of remaining **six** questions.
(3) Assume any **necessary** data but justify the same.
(4) Figures to the **right** indicate **marks**.
(5) Use of scientific **calculator** is **allowed**.

1 a) XYZ farm is engaged in breeding cows. The cows are fed on various products grown on the farm. Because of the need to ensure certain nutrient constituents, it is necessary to buy additional one or two products, which we shall call A and B. The nutrient constituents (vitamins and proteins) in each unit of product are given below.

Nutrient Constituents	Nutrient Constituents		Minimum requirements of nutrient constituents
	A	B	
1	36	6	108
2	3	12	36
3	20	10	100

Product A costs Rs. 20 per unit and product B costs Rs 40 per unit. Determine how much of products A and B must be purchased so as to provide the cow nutrients not less than the minimum required, at the lowest cost. Solve the LP problem graphically. [10]

b) The following is the activity list of a project with time estimates [10]

Activity	Time(days)		
	Optimistic	Most likely	Pessimistic
1-2 (A)	6	6	24
1-3 (B)	6	12	18
1-4 (C)	12	12	30
2-5 (D)	6	6	6
3-5 (E)	12	30	48
4-6 (F)	12	30	42
5-6 (G)	18	30	54

Draw a network. Find expected duration and variance for each activity

What is the probability of the project is not being completed in 80 days?

[Given, for SNV, Z=0.69, area between mean and value of Z is 0.2549].

2 a) Solve the following LPP by simplex method. [10]

Maximize: $Z= 10x_1+6x_2+4x_3$

Subject to: $x_1+x_2+x_3 \leq 100$

$10x_1+4x_2+5x_3 \leq 600$

$2x_1+2x_2+6x_3 \leq 300$

$x_1, x_2, x_3 \geq 0$

b) Find the initial basic feasible solution of the following Transportation Problem by Least Cost Method. [10]

	To			
				Supply
From	2	7	4	5
	3	3	1	8
	5	4	7	7
	1	6	2	14
Demand	7	9	18	

3 a) Solve the following using big M method. [10]

Maximize $Z = 3x_1-x_2$

Subject to the constraints $2x_1+x_2 \leq 2$

$x_1+3x_2 \geq 3$

$x_2 \leq 4$

$x_1, x_2 \geq 0$

(b) The captain of a cricket team has to allot the five middle bating positions to five batsmen. The average runs scored by each batsman at these positions are as follows. [10]

Batsman	Batting Position				
	I	II	III	IV	V
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

Find the assignment of batsmen to positions which will give the maximum number of runs.

4 a) Solve the LPP by Dual Simplex Method. [10]

Minimize $Z = 2x_2+5x_3$

Subject to $x_1+x_2 \geq 2$

$2x_1+x_2+6x_3 \leq 10$

$x_1-x_2+x_3 \geq 4$

$x_1, x_2, x_3 \geq 0$

b) Six jobs have to be processed at three machines A, B, C in order ACB. The time(in hrs) taken by each job on each machine is indicated below. [10]

Jobs	I	II	III	IV	V	VI
M/C A	12	8	7	11	10	5
M/C B	7	10	9	6	10	5
M/C C	3	4	2	5	5	4

Determine the sequence for the jobs so as to minimize the processing time. Determine the total elapsed and idle time of each machine.

5 a) Write short notes on the following. [10]

(i) Different costs associated with inventory problem.

(ii) Dual of a primal in LPP.

b) Solve using Gomory's cutting plane method. [10]

Maximize $z=x_1+2x_2$

Subject to: $3x_1+2x_2 \leq 5$

$x_2 \leq 2$

$x_1, x_2 \geq 0$ and integer.

6 a) Explain the following. [10]

(i) Branch and bound method of solving Traveling Salesman Problem.

(ii) Pure and mixed strategies in Game Theory.

b) The following mortality rates have been observed for a certain type of fuse. There are 1000 fuses in use, and it costs Rs 5 to replace an individual fuse. If all fuses were replaced simultaneously it would cost Rs 1.25 per fuse. It is proposed to replace all fuses at fixed interval of time, whether or not they have burnt out, and to continue replacing out fuses as and when they fail. At what interval the group replacement should be made? Also prove that this optimum policy is superior to the straightforward policy of replacing each fuse only when it fails. [10]

Week	1	2	3	4	5
% failing at the end of the week	5	15	35	75	100

7 a) A small assembly plant assembles PCs through 9 interlinked activities. The time duration for which is given below.

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-6	5-8	6-9	7-8	8-9
Duration	2	2	1	4	8	5	3	1	5	4	3

Draw a network for it. Tabulate total float, free float and independent float. [10]

b) Solve the following game by using the principle of dominance. [10]

		Player B					
		I	II	III	IV	V	VI
Player A	1	4	2	0	2	1	1
	2	4	3	1	3	2	2
	3	4	3	7	-5	1	2
	4	4	3	4	-1	2	2
	5	4	3	3	-2	2	2