Job(i-j)	Duration (days)		
	Optimistic (t_o)	Most likely (t_m)	Pessimistic(t_p)
1-2	3	6	15
1-6	2	5	14
2-3	6	12	30
2-4	2	5	8
3-5	5	11	17
4-5	3	6	15
6-7	3	9	27
5-8	1	4	7
7-8	4	19	28

Draw the Project network and find the expected duration and variance for the project.

(7.5*2=15)

[This question paper contains 8 printed pages.]

Your Roll No...............

Sr. No. of Question Paper : 7538

Unique Paper Code : 61011503

Name of the Paper : Quantitative Techniques for Management

Name of the Course : **Bachelor of Management Studies (BMS), 2023 (LOCF)**
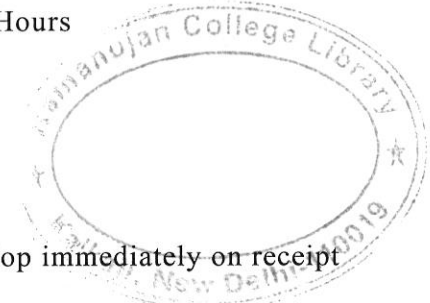
Semester : V

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. **Attempt all questions. Marks are indicated against each question.**

3. Use of simple calculator is allowed.

4. Parts of a questions must be answered at one place. Rough work must be clearly shown with the answer.

P.T.O.

1. A gardener requires at least 20, 24, and 24 units of pesticides X, Y, and Z for his garden. There are two different forms in which the pesticides are available. The spray product contains 10, 4, and 2 unit of X, Y, and Z per bottle. The powder product contains 2, 4, and 8 units of X, Y, and Z per jar. The cost of the liquid product is Rs 6 per bottle and the cost of the dry product is Rs 4 per jar.

    Formulate the above problem as an LPP. Use the simplex method to determine how many of each form should be purchased to minimise the total cost? Write the dual of the given problem and explain its utility. Determine the range of cost of spray product and powder product over which the total optimal cost will remain unchanged. (15)

2. A transportation problem for a company that manufactures products at three plants and ships them to three warehouses is provided below. The plant capacities in units, warehouse demands in units and transportation cost in Rs. per unit are shown in the following table:

(v) What is the shadow price of the resources?

(b) There are five jobs that need to be assigned to one machine each out of the available five machines such that the associated cost of completing a job on a machine is minimum. Using Hungarian assignment method find out the optimal assignment if Machine III can't be assigned to Job A. The table given below indicates cost of completing a job on a particular machine:

Cost (in thousand Rs.)					
		Machines			
		I	II	III	IV	V
Jobs	A	6	12	3	11	15
	B	4	2	7	1	10
	C	8	11	10	7	11
	D	16	19	12	23	21
	E	9	5	7	6	10

(c) Consider the following table summarizing the details of a project:

P.T.O.

5. Attempt **any two** of the following:

(a) Following table provides the optimal solution to a maximization LPP. Answer the questions that follow giving suitable justification:

Basis	Cj	x1	x2	x3	S1	S2	bi
x3	1	4/3	5/3	1	1/3	0	5
S2	0	26/3	16/3	0	-1/3	1	7
	Cj	1	1	1	0	0	

(i) Write the objective function of the given LPP.

(ii) Find the optimal value of the decision variables and objective function.

(iii) Does the problem have another alternate solution.

(iv) If S_1 and S_2 represent slack variables, determine capacity utilization of both resources.

Plant	Warehouse			Plant Capacity
	W1	W2	W3	
P1	22	18	26	350
P2	12	12	10	450
P3	14	20	10	200
Warehouse Demand	250	400	350	

Solve the above transportation problem using Least Cost Method and obtain the optimal transportation schedule to minimize total cost. Comment if the optimal solution is unique or not.   (15)

3. The following table gives the normal time and cost and crash time and cost for the various activities in a project.

Activities	Normal Duration (days)	Crash Duration (days)	Normal Cost (Rs.)	Crash Cost (Rs.)
1-2	6	4	50	80
1-3	5	3	80	150
2-4	5	2	60	90
2-5	8	6	100	300
3-4	5	2	140	200
4-5	2	1	60	80

(i) Draw the network and find the critical path and normal project duration and cost.

(ii) If the indirect costs are Rs. 20 per day, perform crashing to find:

    (a) the optimal duration and the corresponding project cost,

    (b) minimum duration and the corresponding project cost.   (15)

4. Attempt **any two** of the following:

(a) A physician purchases a particular vaccine on Monday of each week. The vaccine must be used within the week following, otherwise it becomes worthless. The vaccine costs Rs.3 per dose and the physician charges Rs. 5 per dose. In the past 50 weeks the physician has administered the vaccine in the following quantities:

Dose per week:	20	30	40	50
No. of Weeks:	5	15	20	10

On the basis of EMV, find how many doses the physician must purchase each week to maximize his profits.

(b) A market analysis group studying car purchasing trends in a certain region has revealed that the buying patterns can be described as follows:

	Hatchback	Sedan	SUV
Hatchback	0.40	0.35	0.25
Sedan	0.10	0.70	0.20
SUV	0.15	0.25	0.65

At present it is estimated that equal number of people buy Hatchback, Sedan and SUV. Assuming that the purchasing trends remain unchanged, find the market shares of the companies:

  (i) at the end of first year;

  (ii) at the end of second year.

(c) Solve the following game:

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	1	2	2	-1
A_2	2	2	3	-2
A_3	3	1	0	-2
A_4	4	3	2	6

                                       (7.5*2)