BE10-R3: APPLIED OPERATIONS RESEARCH

NOTE:

1. **Answer question 1 and any FOUR questions from 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) A manufacturing company makes three different products, each of which requires three operations as part of the manufacturing process. The company can sell off all the products that it can manufacture but its production capacity is limited by the capacity of its operations centre. The data concerning the company is given below:

Product	Manufacturing requirement (hr/unit)			Cost price (Rs.)	Selling price (Rs.)
	Centre I	Centre II	Centre III		
A	1	3	2	11	15
B	3	4	1	12	20
C	2	2	2	10	16
Hours available	160	120	80		

Formulate the above as a linear programming model to maximize the profit of the company.

b) In a particular single-server system, the arrival rate is 5 per hour and service rate is 8 per hour. Assume the conditions for use of the single channel queuing model and find out

i) the probability that the server is idle.

ii) the probability that there are at least two customers in the system.

iii) expected time that a customer is in the queue.

c) Players A and B play a game in which each player has three coins (Rs. 1, Rs. 2, Rs. 5). Each of them selects a coin without the knowledge of the other person. If the sum of the values of the coins is an even number, A wins B's coin. If that sum is an odd number, then B wins A's coin. Develop a payoff matrix of player A in this game.

d) Six jobs go first over machine I and than over machine II. The order of completion of jobs has no significance. The following table gives machines time for the six jobs and two machines:

Job	**Time (in hours)**					
	1	**2**	**3**	**4**	**5**	**6**
Machine I	5	9	4	7	8	6
Machine II	7	4	8	3	9	5

Find the sequence of the job that minimizes the total elapsed time to complete the jobs. Also find the total elapsed time for an optimal sequence.

e) Draw a network for a project which consists of the following activities:

Activities	**Preceding activities**	**Activity duration**
A	--	4
B	--	7
C	--	6
D	A, B	5
E	A, B	7
F	C,D,E	6
G	C,D,E	5

f) Using Vogel's approximation method, find an initial basic feasible solution of the following transportation problem.

D1	D2	D3	D4	Supply
5	3	6	2	19
4	7	9	1	37
3	4	7	5	34
16	18	31	25	

g) Write the dual of the following linear programming

Minimize $z = 8x_1 + 5x_2 + 6x_3$

subject to $x_1 + x_2 + x_3 = 25$

$4x_1 - 5x_2 \geq 10$

$x_1 - x_2 + 2x_3 \leq 48$

$x_1, x_2 \geq 0$

(7x4)

2.

a) Solve the following linear programming problem by Big-M method

Maximize $z = 6x_1 + 4x_2$

subject to $2x_1 + 3x_2 \leq 30$

$3x_1 + 2x_2 \leq 24$

$x_1 + x_2 \geq 3$

$x_1 \geq 0, x_2 \geq 0$

b) A company purchases 9000 parts of a machine for its annual requirements, ordering one month's usage at a time. Each part cost Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. You have been asked to suggest a more economical purchasing policy for the company. What advise would you offer and how much would it save for the company per year?

(9+9)

3.

a) Solve the following problem by dynamic programming

Maximize $z = y_1\ y_2 \ldots . y_n$

subject to, $y_1 + y_2 + \ldots\ldots + y_n = c$ and $y_i \geq 0$, i = 1,…, n.

b) If four jobs are to processed on each of the four machines A, B, C and D in order A B C D. The processing times in minutes are given in the following table. Find the minimum elapsed time when passing is not allowed:

machine / job	A	B	C	D
1	58	14	14	48
2	30	10	18	32
3	28	12	16	44
4	64	16	12	42

(9+9)

4.

a) Using the principle of dominance, solve the following game

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

b) A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking into account the capabilities of salesmen and the nature of districts, the company estimates that the profit per day in rupees for each salesman in each district is as below.

Salesman	District			
	1	2	3	4
A	16	10	14	11
B	14	11	15	15
C	15	15	13	12
D	13	12	14	15

Find the assignment of salesmen to various districts which will yield maximum profit.

(9+9)

5.

a) Use branch and bound method to solve the following integer linear programming problem

Maximize $z = 7x_1 + 9x_2$

subject to $x_1 + 3x_2 \leq 6$

$7x_1 + x_2 \leq 35$

$x_2 \leq 7$

$x_1, x_2 \geq 0$

where x_1, x_2 are integers.

b) The activities involved in a project are given below:

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

i) Draw a network diagram.
ii) Find the critical path.
iii) What will be the effect on the critical path if the most likely time of activity 3-5 gets revised to 14 instead of 11 days given above?

(9+9)

6.

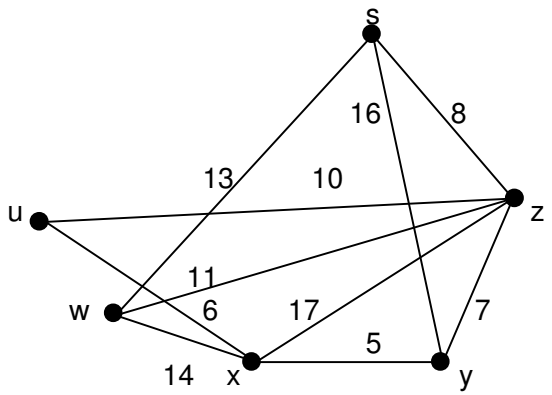
a) On average 96 patients per 24 hours day require the service of an emergency clinic. Also, on average, a patient requires 10 minutes of active attention. It costs the clinic Rs. 100 per patient treated to obtain an average servicing time of 10 minutes. The clinic wishes to decrease the average size of the queue from $\frac{4}{3}$ patients to $\frac{1}{2}$ patients. If each minute of decrease in waiting time of the patient cost Rs. 10 per patient to the clinic, how much the clinic should charge each patient.

b) A company for one of the A-class items, placed 6 order each of size 200 in an year. Given that the ordering cost is Rs. 600, holding cost 40%, cost per unit is Rs. 40, find the economic order quantity and the corresponding cost. Also find the loss to the company in not operating a scientific inventory policy?

(9+9)

7.

a) Find the shortest path from node ***s*** to each other vertex in the following graph



b) Suppose there are two market products of brands A and B respectively. Each of these two brands has exactly 50% of the total market in same period and let the market be of a fixed size. The transition matrix is given below

		To A	To B
From	A	0.9	0.1
	B	0.5	0.5

If the initial market share break down to 50% for each brand then determine their market shares at the end of 3 time periods.

(9+9)