BE10-R4: APPLIED OPERATIONS RESEARCH

NOTE:

1.	**Answer question 1 and any FOUR from questions 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 shopkeeper has a uniform demand of an item at the rate of 50 items per month. He buys it from a supplier at a cost of Rs 6 per item and the cost of ordering is Rs 10 each time. If the stock holding costs are 20% per year of stock value, how frequently should he replenish his stocks?

b) Solve the game whose payoff matrix is given by

		Player B		
		I	II	III
Player A	1	−2	15	−2
	2	−5	−6	−4
	3	−5	20	−8

c) Show that $C = \{(x_1, x_2) : 2x_1 + 3x_2 = 7\} \subset R^2$ is a convex set.

d) A barber shop with only one barber takes exactly 25 minutes to complete one hair cut. If customers arrive in a shop in Poisson fashion at an average rate of one every 40 minutes, how long on the average must a customer wait for service?

e) Draw a network diagram for the following activities from A to F.

Operations	Post-operation
A	Preceedes B, C
B	Preceedes D, E
C	Preceedes D
D	Preceedes F
E	Preceedes G
F	Preceedes G

f) Write the dual, with one unrestricted variable, of the following linear programming problem

Minimize $Z = x_1 + x_2 + x_3$

subject to

$x_1 - 3x_2 + 4x_3 = 5$

$x_1 - 2x_2 \le 3$

$2x_2 - x_3 \ge 4$

$x_1, x_2 \ge 0, x_3$ is unrestricted in sign.

g) Perform only one complete iteration of steepest descent method to find the minimum value of $f(x, y) = (x-2)^2 + (y-3)^2$ starting at $x = 1$ and $y = 1$.

(7x4)

2.

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

Minimize $Z = 4x_1 + 8x_2 + 3x_3$

subject to

$$x_1 + x_2 \geq 2$$

$$2x_1 + x_3 \geq 5$$

and $x_1, x_2, x_3 \geq 0$

b) Find the optimal transportation schedule and an optimal transportation cost of the following cost matrix:

	A	B	C	Availability
1	6	8	4	14
2	4	9	3	12
3	1	2	6	5
Requirement	6	10	15	

(9+9)

3.

a) A manufacturing company purchases 9000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs 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 advice would you offer, and how much would it save per year?

b) Solve the following integer linear programming problem by branch and bound method:

Maximize $Z = 7x_1 + 9x_2$

subject to

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

$$7x_1 + x_2 \leq 35$$

and $0 \leq x_1, x_2 \leq 7$

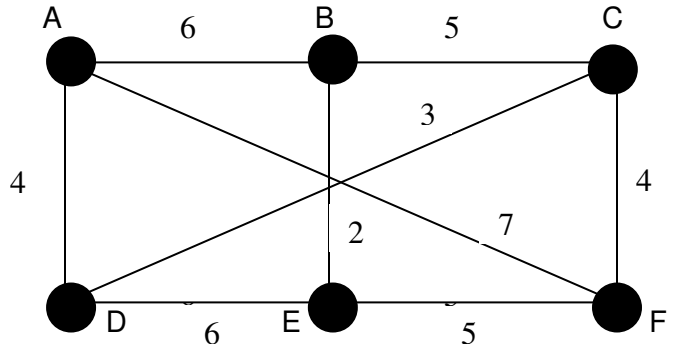
(9+9)

4.

a) Solve the following game by graphical method

		Player A			
		I	II	III	IV
Player B	I	2	2	3	-2
	II	4	3	2	6

b) Use Kruskal's method to find the minimum spanning tree in the following weighted graph:



(9+9)

5.

a) A project has the following time schedule:

Activity	Time	Activity	Time
1-2	4	5-6	4
1-3	1	5-7	8
2-4	1	6-8	1
3-4	1	7-8	2
3-5	6	8-9	1
4-9	5	8-10	8
		9-10	7

Construct a PERT network and compute

i) Total float for each activity

ii) Critical path and time duration of the project.

b) Solve the assignment problem to minimize the cost of tasks where the cost matrix is as follows:

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

(10+8)

6.

a) Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call assumed to be distributed exponentially, with mean 3 minutes. Find the followings:

i) What is the probability that a person arriving at the booth will have to wait?

ii) What is the average length of the queues that is formed time to time?

iii) Find the average number of units in the system.

b) Find the optimal order quantity for a product for which the price breaks are as follows:

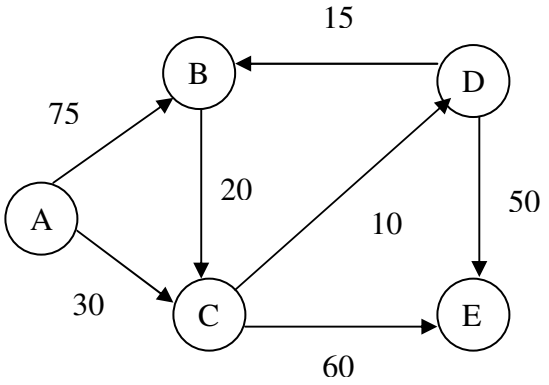
quantity(q)	**Unit cost(Rs)**
$0 \le q < 50$	10
$50 \le q < 100$	9
$100 \le q$	8

The monthly demand for the product is 200 units, the cost of storage is 25% of the unit cost and ordering cost is Rs. 20 per order.

(6+12)

7.

a) In the following network, five towns are connected through permissible routes. This distance in miles between any towns is given on the arc connecting these towns. Find the shortest distance between town A and any other town.



b) Determine the optimal sequence of jobs which minimize the total elapsed time based on the following information:

Job	Processing Time (in hours)				
	1	2	3	4	5
Machine A	5	7	6	9	5
Machine B	2	1	4	5	3
Machine C	3	7	5	6	7

Also compute the minimum total elapsed time.

(9+9)