Duration : 03 Hours   Marks : 80

Instructions: 1. Question number ONE is compulsory

2. Answer any THREE from the remaining FIVE

3. Use graph paper where ever necessary

Q.1.(a). How will you understand that solution is Infeasible, Unbounded and Infinite number of solution in graphical method. (05)

(b) Write dual of following problem. (10)

$$\text{Maximize } Z = 7x_1 + 5x_2 - 2x_3$$

Subject to

$$x_1 + x_2 + x_3 = 10$$
$$2x_1 - x_2 + 3x_3 \leq 16$$
$$3x_1 + x_2 - 2x_3 \geq 0$$
$$x_1, x_2 \geq 0, \ x_3 \text{ unrestricted}$$

(c) Solve the following Assignment problem of four jobs and three men. Time to perform jobs by different men are given. (05)

Men	Job			
	J1	J2	J3	J4
M1	7	5	8	4
M2	5	6	7	4
M3	8	7	9	4

Q.2. (a) A company buys 2000 bats annually. A fixed cost of Rs. 50 is incurred each time an order is placed. Inventory carrying cost is estimated at 20 %. Supplier offers a 10 % discount in price per bat of Rs. 100 if order is placed more than or equal to 150 bats at a time. In what order size should the company purchase. (10)

(b) Solve the following transportation problem to minimise total transportation cost. (10)

	A	B	C	Capacity
X	5	1	7	10
Y	6	4	6	80
Z	3	2	5	15
Demand	75	20	50	

Q.3. (a) Solve by graphical method (10)

Maximise,

$$Z = 3X_1 + 4X_2$$

S.t.,

$$X_1 - X_2 \geq 0, \ ; \ 2.5X_1 - X_2 \leq -3, \ X_1 \ \& \ X_2 \geq 0$$

(b) The following data is pertaining to a project with normal time and crash time. (10)

Jobs	Normal		Crash	
	Time (Days)	Cost (Rs)	Time (Days)	Cost (Rs)
1 – 2	8	100	6	200
1 – 3	4	150	2	350
2 – 4	2	50	1	90
2 - 5	10	100	5	400
3 – 4	5	100	1	200
4 – 5	3	80	1	100

(i) If the indirect cost is Rs. 100 per day, find the least cost schedule (Optimum Duration)

(ii) What is the minimum duration

[Turnover

Q.4. (a) Customers arrive at random. Probability of inter arrival time and service time are given as under

Inter Arrival Time (Minutes)	Probability	Service Time (Minutes)	Probability
1	0.1	1.0	15
2	0.2	1.5	20
3	0.3	2.0	25
4	0.3	2.5	30
5	0.1	3.0	10

Estimate the average waiting time and queue length of customer by using seven simulations

Random Number: 5887, 4739, 2328, 6997, 3569, 5587, 6952 (10)

(b) A self service store employs one cashier at its counter. An average of nine customers arrive every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find

(a) Average number of customer in the system (10)

(b) Average time a customer spends in the queue

(c) Utilization factor

(d) Probability that customer spends more than 4 minutes in the system

Q.5. (a) For the upcoming season, farmer can plant corn (A1), wheat (A2) or soyabin (A3) or use the land for grazing (A4). The payoff associated with the different actions are influenced by the amount of rain : Heavy rainfall (S1), Moderate rainfall (S2), Light rainfall or draught. The payoff matrix (in thousand Rs.) is estimated as

	S1	S2	S3	S4
A1	-20	60	30	-5
A2	40	50	35	0
A3	-50	100	45	-10
A4	12	15	15	10

Find, which crop will be produced using Maximax, Maximin, Laplace and Hurwicz criteria for decision under uncertainty. (10)

(b) Solve by Big- M method (10)

Minimize,

$Z = 4X1 + X2$

Subject to,

$3X1 + X2 = 3 : 4X1 + 3X2 \geq 6; X1 + 2X2 \leq 4 : X1, X2 \geq 0$

[Turnover

Q.6. (a) Solve the following game by method of metrices   (10)

7	1	7
9	-1	1
5	7	6

(b) What is critical path, float and resource levelling in project management. (05)

(c) What is decision under risk and decision tree in decision under uncertainty.(05)