Code No: R31032 **R10** **Set No: 1**

III B.Tech. I Semester Regular Examinations, November/December - 2012

OPERATIONS RESEARCH

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Use Big M method to solve the following LP problem:
   Minimize $Z = 2x_1 + 3x_2$
   Subjected to the constraints :
   $$x_1 + x_2 \geq 6$$
   $$7x_1 + x_2 \geq 14$$
   $$x_1, x_2 \geq 0$$
2. Consider the problem of allocating raw materials from four different warehouses to five different plants. The availability of the raw material in the four warehouses are 25 ton, 30ton, 20ton and 30ton. The demands of the raw material in the five plants are 20ton, 20ton, 30ton, 10ton and25ton. It is not possible to shift the raw material from warehouse 4 to plant 4 because of steep road. From the unit costs of transportation (in hundreds) given in table 1. Find the optimal shipping plan for the raw material (Use North west cell method to obtain initial feasible solution).

Table 1

		Plant				
		1	2	3	4	5
warehouse	1	10	2	3	15	9
	2	5	10	15	2	4
	3	15	5	14	7	15
	4	20	15	13	-	8

3. A system consists of 10000 electric bulbs. When any bulb fails, it is replaced immediately and the cost of replacing a bulb individually is Re.1/- only. If all the bulbs are replaced at the same time, the cost per bulb will be Rs. 0.35. The percent surviving *i.e.* $S(t)$ at the end of month 't' and $P(t)$ the probability of failure during the month 't' are as given in table 2. Find the optimum replacement policy.

Table 2

t in months:	*0*	*1*	*2*	*3*	*4*	*5*	*6*
$S(t)$:	100	97	90	70	30	15	0
$P(t)$:	---	0.03	0.07	0.20	0.40	0.15	0.15

4. (a) Explain strategy, saddle point and value of the game with respect to game theory.
   (b) Consider the payoff matrix of player A is shown in table 3 and solve it optimally using graphical method:

Table 3

		Player B				
		1	2	3	4	5
Player A	1	3	0	6	-1	7
	2	-1	5	-2	2	1

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5. In a railway marshalling yard, good train arrives at the rate of 30 trains per day. Assume that the inter arrival time follows an exponential distribution and the service time is also to be assumed as exponential with a mean of 36 minutes. Calculate: (*a*) The probability that the yard is empty, (*b*) The average length assuming that the line capacity of the yard is 9 trains.

6. Find the optimal order quantity for a product where the annual demand for the product is 5400units, the cost of storage per unit per year is 30% of the unit cost and ordering cost per order is Rs. 600. The unit costs are given below:

Quantity	Unit Cost
$0 \le Q_1 \le 2400$	Rs.12.00
$2400 \le Q_2 \le 3000$	Rs.10.00
$3{,}000 \le Q_3$	Rs. 8.00

7. Solve the following Linear Programming (L.P.) problem using Dynamic Programming (D.P.) technique.

Maximize $Z = 5x + 9y$

subject to

$-x + 3y \le 3$

$5x + 3y \le 27$ and both x and y are ≥ 0

8. (a) What is the classification of simulation models? Explain the advantage and limitations of simulation techniques.

(b) With the help of a single server queuing model having inter-arrival and service times constantly 1.4 minutes and 3 minutes respectively, explain discrete simulation technique taking 10 minutes as the simulation period. Find from this average waiting time and percentage of idle time of the facility of a customer. Assume that initially the system is empty and the first customer arrives at time t = 0.

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Code No: R31032 **R10** **Set No: 2**

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1. (a) What is a graphical optimization? What are its limitations?
   (b) Solve the following LP problem using graphical method
   Maximize $Z = 6x_1 + 8x_2$
   Subjected to the constraints : $5x_1 + 10x_2 \leq 60$,
   $4x_1 + 4x_2 \leq 40$, $x_1, x_2 \geq 0$

2. (a) Explain the graphical method to solve the two job M machines sequencing problem with given technological ordering for each job. What are the limitations of the above method?
   (b) Consider 3 machine and 5 job flow shop problem as shown in the table 1. Determine the optimal sequence of jobs that minimize the total elapsed time. Processing time on machines is in hours.

Table 1

Job	Machine1	Machine2	Machine3
1	11	10	12
2	13	8	20
3	15	6	15
4	12	7	19
5	20	9	7

3. (a) Machine *A* costs Rs. 45,000/- and the operating costs are estimated at Rs. 1000/- for the first year, increasing by Rs. 10,000/- per year in the second and subsequent years. Machine *B* costs Rs.50000/- and operating costs are Rs. 2000/- for the first year, increasing by Rs. 4000/- in the second and subsequent years. If we now have a machine of type *A*, should we replace it by *B*? If so when? Assume both machines have no resale value and future costs are not discounted.
   (b) Find the cost per period of individual replacement policy of an installation of 300 bulbs, given the following:
   (i) Cost of individual replacement of bulb is Rs. 2/- per bulb.
   (ii) Conditional probability of failure of bulbs is as follows:

Weekend:	*0*	*1*	*2*	*3*	*4*
Probability of failure:	0	0.1	0.3	0.7	1.0

4. (a) Explain strategy, saddle point and value of the game with respect to game theory.
   (b) Solve the game whose pay-off matrix is given by graphical method:

	B_1	B_2	B_3	B_4
A_1	4	-2	3	-1
A_2	-1	2	0	1
A_3	-2	1	-2	0

5. (a) What are the characteristics of queuing models ? Explain them.
(b) The arrival rates of break down machines at a maintenance shop follows Poisson distribution with a mean of 4 per hour. The service rate of machines by a maintenance mechanic also follows Poisson distribution with a mean of 3 per hour. The down time cost per hour of a break down machine is Rs. 200. The labor rate per hour is Rs. 50. Determine the optimal number of maintenance machines to be employed to repair the machines such that the total cost is minimized.

6. (a) Derive the EOQ formula for the purchase modal without shortages?
(b) A company wants to determine the economic order size of each of the three items which are stocked in its stores. The details of the items are presented in fallowing table. The maximum space availability is 500 square metres. Find the economic order size subject to space constraint.

Item Number			
	1	2	3
Demand/ Year(ton)	1000	1500	750
Ordering cost/order	500	700	300
Carrying cost/ton/year(Rs)	50	80	100
Space requirement/ton (sq.mt)	2	3	1

7. (a) What are the characteristics of dynamic programming?
(b) Solve the given L.P. Model by using dynamic programming technique.

Max $Z = a + 9b$

Subject to.

$2a + 1b \leq 25$

$0a + 1b \leq 11$

and

a and b are ≥ 0,

8. Two persons X and Y work on a two – station assembly line. The distribution of activity times at their stations are

Time in seconds	Time frequency for X	Time frequency for Y
10	3	2
20	7	3
30	10	6
40	15	8
50	35	12
60	18	9
70	8	7
80	4	3

(a) Simulate operation of the line for eight items
(b) Assuming Y must wait until X completes the first item before starting work, will he have to wait to process any of the other eight items?

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Code No: R31032 **R10** **Set No: 3**

III B.Tech. I Semester Regular Examinations, November/December - 2012

OPERATIONS RESEARCH

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

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1. Use Simplex method to solve the following problem:
   Maximize $Z = 2x_1 + 5x_2$
   Subjected to the constraints :
   $3x_1 + x_2 \leq 21$, $x_1 + 4x_2 \leq 24$
   $x_1 + x_2 \leq 9$, $x_1, x_2 \geq 0$
2. (a) What is traveling sales man problem? Explain how would you obtain optimal solution to it.
   (b) Solve the following Assignment problem

Jobs \ operator	1	2	3	4	5
	10	12	15	12	8
	7	16	14	14	11
	13	14	7	9	9
	12	10	11	13	10
	8	13	15	11	15

3. There are 1,000 bulbs in the system. The percentage surviving, S(i) at the end of month is given below:

End of Month	:	0	1	2	3	4	5
Bulbs in operation- at the end of month S(i)	:	100	90	75	55	30	0

   The group replacement of 1000 bulbs costs Rs.100 and individual replacement is Rs.0.50 per bulb. Suggest suitable replacement policy.

4. (a) Explain Maximin and Minimax principle with respect to game theory.
   (b) Consider the game having following payoff table. Determine the optimal strategy for each player.

strategy		Player 1	2	3	4
Player 1	1	2	-3	-1	1
	2	-1	1	-2	2
	3	-1	2	-1	3

5. (a) Explain the various types of queues by means of a sketch and also give the situations for which each is suitable
(b) A transport company has a single unloading berth with vehicles arriving in a Poisson fashion at an average rate of three per day. The unloading time distribution for a vehicle with .N. unloading workers is found to be exponentially with an average unloading time (1/2) x N days. The company has a large labour supply without regular working hours, and to avoid long waiting lines, the company has a policy of using as many unloading group of workers in a vehicle as there are vehicles waiting in line or being unloaded. Under these conditions find (*a*) What will be the average number of unloading group of workers working at any time? (*b*) What is the probability that more than 4 groups of workers are needed?

6. Find the optimal order quantity for a product where the annual demand for the product is 500 units, the cost of storage per unit per year is 10% of the unit cost and ordering cost per order is Rs. 180.00. the unit costs are given below:

Quantity	**Unit Cost**
$0 \leq Q_1 \leq 500$	Rs.25.00
$500 \leq Q_2 \leq 1,500$	Rs.24.80
$1,500 \leq Q_3 \leq 3,000$	Rs.24.60
$3,000 \leq Q_4$	Rs.24.40

7. Consider the following linear programming problem: Maximize $Z = 3x1 + 5x2$,
Subjected to the constraints :

$$x_1 \leq 4$$
$$2x_2 \leq 12$$
$$3x_1 + 2x_2 \leq 18$$
$$\text{And} \quad x_1, x_2 \geq 0$$

Link this problem with Dynamic programming and solve it.

8. (a) Define simulation and its advantages also discuss various application area of simulation
(b) Explain with a flow chart the steps in conducting simulation experiment of an inventory system considering the probabilistic demand and probabilistic Lead-times. Identify the decision variables and the mathematical relationship.

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1. (a) List and explain the assumptions of Linear programming problems
   (b) Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirement of vitamin A and vitamin B is 100 units and 120 units respectively. Find the minimum cost of product mix by the graphical method?

2. (a) Explain the difference between transportation problem and an assignment problem
   (b) Find the optimal solution to the following transportation problem

		Ware Houses				Capacity
		W_1	W_2	W_3	W_4	
Factory	F_1	10	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	80	70	20	18
	Demand	5	8	7	14	

3. There are 1,000 bulbs in the system. Survival rate is given below:

Week	:	0	1	2	3	4
Bulbs in operation- at the end of week	:	1000	850	500	200	00

   The group replacement of 1000 bulbs costs Rs.100 and individual replacement is Rs.0.50 per bulb. Suggest suitable replacement policy.

4. (a) Explain Maximin and Minimax principle with respect to game theory
   (b) Consider the game having the following payoff table.

Strategy		Player 2	
		1	2
Player 1	1	3	−2
	2	−1	2

   Determine the value of the game by the graphical procedure

5. Arrivals at a telephone booth are considered to be following Poisson law of distribution with an average time of 10 minutes between one arrival and the next. Length of a phone call is assumed to be distributed exponentially with mean 3 minutes.
   (i) What is the probability that a person arriving at the booth will have to wait?
   (ii) What is the average length of queue that forms from time to time?

6. (a) List and explain different types of costs in inventory system
   (b) The demeand for an item is 6000 units per year. Its production rate is 1000 units per month. The carrying cost is Rs. 50/unit/year and set up cost is Rs. 2000. set up. The shortage cost is Rs. 1000 per unit per year. Find various parameters of the inventory system

7. (a) What are the classification of simulation models? explain the advantage and slimitations of simulation technique
   (b) With the help of a single server queuing model having inter-arrival and service times constantly 1.4 minutes and 3 minutes respectively, explain discrete simulation technique taking 10 minutes as the simulation period. Find from this average waiting time and percentage of idle time of the facility of a customer. Assume that initially the system is empty and the first customer arrives at time t = 0.

8. Write a short note on the following
   (a) Bellman's principle of optimality
   (b) ***n*** jobs through two machines
   (c) Deterministic models

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