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

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

OPERATIONS RESEARCH

(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) What is an Operations Research model? Discuss the advantages and limitation of good Operations Research model.
   (b) Use the graphical method to solve the problem:
   Maximize $Z = 2x_1 + x_2$,
   Subject to
   $x_2 \leq 10$
   $2x_1 + 5x_2 \leq 60$
   $x_1 + x2 \leq 18$
   $3x_1 + x_2 \leq 44$ and $x_1 \geq 0$, $x_2 \geq 0$.

2. Solve the following transportation problem and obtain the optimum solution

Destination

Source	A	B	C	D	E	SUPPLY
W	20	19	14	21	16	40
X	15	20	13	19	16	60
Y	18	15	18	20	-	70
Z	0	0	0	0	0	50
DEMAND	30	40	50	40	60	

3. Machine *A* costs Rs. 45,000/- and the operating costs are estimated at Rs. 1,000/- for the first year, increasing by Rs. 10,000/- per year in the second and subsequent years. Machine *B* costs Rs.50,000/- and operating costs are Rs. 2,000/- for the first year, increasing by Rs. 4,000/- 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.

4. (a) What are the assumptions made to solve the game problem? Explain?
   (b) Find the range of values of *p* and *q* which will render the entry (2,2) a saddle point in the game with the following payoff matrix.

		B		
		I	II	III
A	I	1	q	3
	II	P	5	10
	III	6	2	3

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5. At a public telephone booth in a post office arrivals are considered with an average inter-arrival time of 12 minutes. The length of phone call may be assumed to be distributed exponentially with an average of 4 minutes. Calculate the following:
   (i) What is the probability that a fresh arrival will not have to wait for phone?
   (ii) What is the probability that an arrival will have to wait more than 10 minutes before the phone is free?
   (iii) What is the average length of queues that form from time to time?
   (iv) What is the fraction of time is the phone busy?

6. The demand for a product is 600 units per week, and the items are withdrawn at a constant rate. The setup cost for placing an order to replenish inventory is Rs. 250. The unit cost of each item is Rs.30, and the inventory holding cost is Rs.0.5 per item per week.
   (i) Assuming shortages are not allowed, determine how often to order and what size the order should be.
   (ii) If shortages are allowed but cost Rs.20 per item per week, determine how often to order and what size the order should be.

7. Solve the following Linear Programming (L.P.) problem using Dynamic Programming (D.P.) technique.
   Maximize $5x + 9y$ subject to
   $-x + 3y \leq 3$,
   $5x + 3y \leq 27$ and both x and y are ≥ 0.

8. With the help of an example explain the additive multiplicative and mixed types of the congruence random number generators.

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Code No: R31032

R10

Set No: 2

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

OPERATIONS RESEARCH

(Mechanical Engineering)

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

Answer any FIVE Questions
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1. (a) Discuss three Operations Research models
   (b) Use the graphical method to solve the problem:
   Maximize $Z = 10x_1 + 20x_2$,
   subject to
   $-x_1 + 2x_2 \leq 15$
   $x_1 + x_2 \leq 12$
   $5x_1 + 3x_2 \leq 45$ and $x_1 \geq 0, x_2 \geq 0$.

2. A manufacturing organization has 3 factories located at *X*, *Y* and *Z*. The centralized planning cell has to decide on allocation of 4 orders over the 3 factories with a view to minimizing the total cost to the organization, Demand and capacity and cost details are given as under:

Customer	*Demand per month in units.*
A	960
B	380
C	420
D	240

Capacities and Costs (Rs.).

Factories	*Capacity units per month*	*Overhead costs in Rs, per month*	*Direct cost in Rs. per unit.*
X	400	400	2.50
Y	900	720	3.00
Z	640	320	3.50

Shipping cost in Paise per unit dispatch.

	TO			
FROM	A	B	C	D
X	50	70	40	35
Y	45	75	40	55
Z	70	65	60	75

It is also possible to produce 25% higher than the capacity in each factory by working overtime at 50% higher in direct costs.

(i) Build a transportation model so that the total demand is met with.

(ii) Do the allocation of factory capacity by minimum cost allocation and check the solution for optimality.

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

3. The maintenance cost and resale value per year of a machine whose purchase price is Rs. 7000/ - is given below:

Year	1	2	3	4	5	6	7	8
Maintenance Cost in Rs.	900	1200	1600	2100	2800	3700	4700	5900
Resale Value in Rs.	4000	2000	1200	600	500	400	400	400

When should the machine be replaced?

4. Two players P and Q play the game. Each of them has to choose one of the three colours: White (W), Black (B) and Red (R) independently of the other. Thereafter the colours are compared. If both P and Q has chosen white (W, W), neither wins anything If player P selects white and Player Q black (W, B), player P loses Rs.2/- or player Q wins the same amount and so on. The complete payoff table. Find the optimum strategies for P and Q and the value of the game.

5. A repairman is to be hired to repair machines, which break down at an average rate of 3 per hour. The breakdown follows Poisson distribution. Non - productive time of a machine is considered to cost Rs.16/- per hour. Two repairmen have been interviewed. One is slow but cheap while the other is fast but expensive. The slow worker charges Rs. 8/- per hour and the services breakdown machines at the rate of 4 per hour. The fast repairman demands Rs. 10/- per hour and services at an average rate of 6 per hour. Which repairman is to be hired?

6. (a) A company has a demand of 12,000 units per year for an item and it can produce 2000 items per month. The cost of one setup is Rs. 400/- and the holding cost per unit per month is Rs. 0.15. Find the optimum lot size and the total cost per year, assuming the cost of one unit as Rs.4/-. Also find the maximum inventory, manufacturing time and total time.
(b) What are the different types of inventory models? Explain?

7. *(a) Explain the* characteristics of dynamic programming
(b) Minimize $z = a^2 + b^2 + c^2$ subject to
$a + b + c \leq 15$ and all a, b, c are ≥ 0

8. With the help of an example explain the additive multiplicative and mixed types of the congruence random number generators.

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R10

Set No: 3

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

OPERATIONS RESEARCH

(Mechanical Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1. A company manufactures three products namely *X*, *Y* and *Z*. Each of the product require processing on three machines, Turning, Milling and Grinding. Product *X* requires 10 hours of turning, 5 hours of milling and 1 hour of grinding. Product *Y* requires 5 hours of turning, 10 hours of milling and 1 hour of grinding, and Product Z requires 2 hours of turning, 4 hours of milling and 2 hours of grinding. In the coming planning period, 2700 hours of turning, 2200 hours of milling and 500 hours of grinding are available. The profit contribution of *X*, *Y* and Z are Rs. 10, Rs.15 and Rs. 20 per unit respectively. Find the optimal product mix to maximize the profit.

2. A department head has 4 subordinates and 4 tasks to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. His estimate of the times each man would take to perform each task is given in the effectiveness matrix below. How should the tasks be allocated one to a man so as to minimize the total man-hours?

		MAN			
		I	II	III	IV
Tasks	A	8	26	17	11
	B	13	28	4	26
	C	38	19	18	15
	D	19	26	24	10

3. A fleet owner finds form his past records that the cost per year of running a vehicle whose purchase price is Rs. 50000/- are as under:

Year	1	2	3	4	5	6	7
Maintenance Cost in Rs.	5000	6000	7000	9000	21500	18000	18000
Real Value in Rs.	30000	15000	7500	3750	2000	2000	2000

Thereafter running cost increases by Rs.2000/- per year but resale value remains constant at Rs. 2000/-. At what stage the replacement is due?

4. Solve the game whose payoff matrix is:

	B			
		I	II	III
A	I	1	7	2
	II	6	2	7
	III	5	1	6

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5. A mechanic repairs 4 machines. The mean time between service requirements is 5 hours for each machine and forms an exponential distribution. The mean repair time is 1 hour and also follows the same distribution pattern. Machine down time costs Rs. 25/- per hour and the mechanic costs Rs. 55/- per day. Find (i) Expected number of operating machines, (ii) the expected down time cost per day, (iii) Would it be economical to engage two mechanics, each repairing only two machines?

6. Suppose that the demand for a product is 30 units per month and the items are withdrawn at a constant rate. The setup cost each time a production run is undertaken to replenish inventory is Rs. 150. The production cost is Rs.10 per item, and the inventory holding cost is Rs. 3.0 per item per month. (i) Assuming shortages are not allowed, determine how often to make a production run and what size it should be. (ii) If shortages are allowed but cost Rs.30 per item per month, determine how often to make a production run and what size it should be.

7. A vessel is to be loaded with stocks of 3 items. Each item '*i*' has a weight of *wi* and a value of *vi*. The maximum cargo weight the vessel can take is 5 and the details of the three items are as follows:

j	*wj*	*vj*
1	1	30
2	3	80
3	2	65

Develop the recursive equation for the above case and find the most valuable cargo load without exceeding the maximum cargo weight by using dynamic programming.

8. Classification of simulation models? advantages of simulation? limitations of simulation technique.

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Code No: R31032

R10

Set No: 4

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

OPERATIONS RESEARCH

(Mechanical Engineering)

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

Answer any FIVE Questions
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*****

1. The Apex Television Company has to decide on the number of 27- and 20-inch sets to be produced at one of its factories. Market research indicates that at most 40 of the 27-inch sets and 10 of the 20-inch sets can be sold per month. The maximum number of work-hours available is 500 per month. A 27-inch set requires 20 work-hours and a 20-inch set requires 10 work-hours. Each 27-inch set sold produces a profit of Rs.1200 and each 20-inch set produces a profit of Rs.800. A wholesaler has agreed to purchase all the television sets produced if the numbers do not exceed the maxima indicated by the market research. A. Formulate a linear programming model for this problem B. Use the graphical method to solve this model.

2. (a) Solve the given assignment problem

Possible Places

		A	B	C	D	E
	M_1	16	22	13	21	25
	M_2	9	7	12	6	15
Machines	M_3	13	16	15	12	16
	M_4	21	24	17	28	26
	M_5	14	10	12	11	15

(b) What are the assumptions considered in solving inventory problem?

3. A fleet owner finds form his past records that the cost per year of running a truck and resale values whose purchase price is Rs. 6000/- are given as under. At what stage the replacement is due?

Year	1	2	3	4	5	6	7	8
Maintenance Cost in Rs.	1000	1200	1400	1800	2300	2800	3400	4000
Real Value in Rs.	3000	1500	750	375	200	200	200	200

4. Use the concept of dominance to solve the game.

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

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5. Consider a self-service store with one cashier; assume Poisson arrivals and exponential service times. Suppose that nine customers arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes. Find: (i) The average number of customers queuing for service, (ii) The probability of having more than 10 customers in the system, (iii) The probability that a customer has to queue for more than 2 minutes. If the service can be speeded up to 12 in 5 minutes, by using a different cash register, what will be the effect on the quantities of (i), (ii) and (iii) above?

6. The demand for a product is 600 units per week, and the items are withdrawn at a constant rate. The setup cost for placing an order to replenish inventory is Rs. 250. The unit cost of each item is Rs.30, and the inventory holding cost is Rs.0.5 per item per week. (i) Assuming shortages are not allowed, determine how often to order and what size the order should be. (ii) If shortages are allowed but cost Rs.20 per item per week, determine how often to order and what size the order should be.

7. The owner of a chain of four grocery stores has purchased six crates of fresh strawberries. The estimated probability distribution of potential sales of the strawberries before spoilage differs among the four stores. The following table gives the estimated total expected profit at each store, when it is allocated various numbers of crates:

		Stores			
Number of crates		1	2	3	4
	0	0	0	0	0
	1	4	2	6	2
	2	6	4	8	3
	3	7	6	8	4
	4	7	8	8	4
	5	7	9	8	4
	6	1	10	8	4

For administrative reasons, the owner does not wish to split crates between stores. However he is willing to distribute zero crates to any of his stores.

8. 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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