Code No: M0321/R07

Set No. 1

IV B.Tech I Semester Supplementary Examinations, Feb/Mar 2011
OPERATIONS RESEARCH
**(Common to Mechanical Engineering, Mechatronics, Electronics &
Telematics, Production Engineering and Automobile Engineering)**

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) What are the advantages and limitations of LP problem?

   (b) Old hens can be bought at Rs 30 each and young ones at Rs 50 each. The old hens lay 3 eggs per week and the young ones lay 6 eggs per week, each egg being worth Rs.1.75 paise. A hen (young or old) costs Rs 3 per week to feed. I have only Rs 100 to spend for hens. How many of each kind should I buy to give a profit of more than Rs 6 per week, assuming that I cannot house more than 20 hens. [6+10]

2. (a) Describe the transportation problem with its general mathematical formulation.

   (b) Find the optimum solution to the transportation problem given in figure 2b for which the cost, origin-availabilities, and destination-requirements are given. [6+10]

To

From	A	B	C	D	E	a_i
I	3	4	6	8	8	20
II	2	10	1	5	30	30
III	7	11	20	40	15	15
IV	2	1	9	14	18	13
b_j →	40	6	8	18	6	78

Figure 2b

3. It has been suggested by a data processing firm that a company adopts the policy of periodically replacing all the tubes in a certain piece of equipment. A given type of tube is known to have mortality distribution as shown in the following table:

Tube failures/week :	1	2	3	4	5
Probability of failure :	0.3	0.1	0.1	0.2	0.3

The cost of replacing the tubes on an individual basis is estimated to be Rs 1.00 per tube and the cost of group replacement policy average Re 0.30 per tube. Compare the preventive replacement with that of remedial replacement.

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4. (a) Solve the game given in figure 4 by reducing to 2×2 game by graphical method.

(b) Explain two person zero sum games. [10+6]

Player B

		I	II
	I	-6	7
Player A	II	4	-5
	III	-1	-2
	IV	-2	5
	V	7	6

Figure 4

5. (a) Explain the characteristics of waiting line models.

(b) A self-service store employs one cashier at its counter. Nine customers arrive on an average 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

   i. Average number of customers in the system.
   ii. Average number of customers in queue or average queue length.
   iii. Average time a customer spends in the system.
   iv. Average time a customer waits before being served. [6+10]

6. A T.V. dealer finds that costs of holding a television in stock for a week is Rs.20, customers who cannot obtain new television immediately tend to go to anther dealer; and the estimates that for every customer who does not get immediate delivery he losses on an average Rs.200. For one particular model of TV, the probabilities for a demand 0, 1, 2, 3, 4 and 5 in week are 0.05, 0.1, 0.2, 0.2 and 0.15 respectively. How many televisions per week should the dealer order? [16]

7. Solve the following LPP by dynamic programming:
   Minimize $Z = x_1 + 3x_2 + 4x_3$
   Subject to
   $$2x_1 + 4x_2 + 3x_3 \geq 60,$$
   $$3x_1 + x_2 + 3x_3 \geq 90$$
   $$x_1, x_2, x_3 \geq 0.$$ [16]

8. Define simulation. Discuss about limitations of simulation. [16]

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Set No. 2

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1. (a) What are the advantages of using linear programming.

   (b) A former has 100 acre farm. He can sell all tomatoes, lettuce, or radishes he can raise. The price he can obtain is Rs 1.00 per kg for tomatoes, Rs 0.75 a head for lettuce and Rs 2.00 per kg for radishes. The average yield per acre is 2000 kg of tomatoes, 3000 heads of lettuce and 1000 kgs of radishes. Fertilizer is available at Rs 0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce, and 50 kgs for radishes. Labour required for sowing and harvesting per acre is 5 man-days for tomatoes and radishes, and 6 man-days for lettuce. A total of 400 man-days of labour are available at Rs 20.00 per man-day. Formulate this as a Linear-Programming model to maximize the formers total profit.   [6+10]

2. Consider the problem of assigning five operators to five machines. The assignment costs are given in figure 2.

	M_1	M_2	M_3	M_4	M_5
A	7	7	–	4	8
B	9	6	4	5	6
C	11	5	7	–	5
D	9	4	8	9	4
E	8	7	9	11	11

Figure 2

Operator A cannot be assigned to machine M3 and operator C cannot be assigned to machine M4. Find the optimum assignment schedule.   [16]

3. (a) A company runs a machine shop containing an expensive drill press that must be replaced periodically as it wears out. The Vice-President of the company has just authorized the installing of a new model but has requested you to devise an optimal replacement plan of next seven years, after which the drill

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press will not needed. State what information you will need and how you will use it.

(b) Find the cost period of individual replacement of an installation of 300 lighting bulbs, given the following:

i. Cost of replacing individual bulb is Rs. 3

ii. Conditional probability of failure is given below: [6+10]

Week number :	0	1	2	3	4
Conditional probability of failure :	0	1/10	1/3	2/3	0

4. A company management and the labour union are negotiating a new three-year settlement. Each of these has 4 strategies.

(a) Hard and aggressive bargaining

(b) Reasoning and logical approach

(c) Legalisitic strategy

(d) Conciliatory approach.

The costs to the company are given for every pair of strategy choice given in figure 4.   [16]

Company strategies

Union strategies		I	II	III	IV
	I	20	15	12	35
	II	25	14	8	10
	III	40	2	10	5
	IV	-5	4	11	0

Figure 4

5. In a departmental store one cashier is there to serve the customers. And the customers pick-up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming Poisson arrival rate and exponential distribution for service rate, find:

(a) Average number of customers in the system.

(b) Average number of customers in the queue or average queue length.

(c) Average time a customer spends in the system.

(d) Average time a customer waits before being served.   [16]

6. (a) Discuss about significance of inventory.

(b) A stockist purchases an item at the rate of Rs. 40 per piece from a manufacturer. 2,000 units of the item are required per year. What should be the order quantity per order if the cost per order is Rs.15 and the inventory charges per year are 20 per cent? [6+10]

7. Use dynamic programming to
   Max Z = $2x_1 + 3x_2$
   subject to constraint

   $$x_1 + x_2 \leq 1$$
   $$x_1 + x_2 \leq 3$$
   $$x_1 + x_2 \geq 0$$
   and $\quad x_1, x_2, x_3 \geq 0.$ [16]

8. Define simulation. What are the advantages and disadvantages? [16]

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Set No. 3

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1. (a) Describe briefly the different phases of OR.

   (b) What are the essential characteristics of OR? Explain the role of computers
       in this field.   [8+8]

2. Consider the problem of assigning five operators to five machines. The assignment
   costs are given in figure 2.

	M$_1$	M$_2$	M$_3$	M$_4$	M$_5$
A	7	7	–	4	8
B	9	6	4	5	6
C	11	5	7	–	5
D	9	4	8	9	4
E	8	7	9	11	11

Figure 2

Operator A cannot be assigned to machine M3 and operator C cannot be assigned
to machine M4. Find the optimum assignment schedule.   [16]

3. (a) Explain with examples for the failure mechanism of items.

   (b) A truck owner from his past experience estimated that the maintenance cost
       per year of a truck whose purchase price is Rs. 1,50,000 and the resale value
       of truck will be as given below :

Year	1	2	3	4	5	6	7	8
Maintenance costs (Rs.) :	10,000	50,000	20,000	25,000	30,000	40,000	45,000	50,000
Resale value (Rs.) :	1,30,000	1,20,000	1,15,000	1,05,000	90,000	75,000	60,000	50,000

Determine at which time it is profitable to replace the truck.   [6+10]

4. (a) What are the assumptions made in the theory of games?

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(b) Obtain the optimal strategies for both players and the value of the game for two-person zero-sum game whose payoff matrix is given in figure 4b.   [8+8]

Player A	Player B	
	B_1	B_2
A_1	-6	7
A_2	4	-5
A_3	-1	-2
A_4	-2	5
A_5	7	-6

Figure 4b

5. A bank has two tellers working on savings accounts. The first teller handles withdrawals only while the second teller handles deposits only. It has been found that the service time distribution for the deposits and withdrawals both are exponential with mean service time 3 minutes per customer. Depositors are found to arrive in a Poison fashion throughout the day contains 8 hours of working with mean arrival rate 16 per hour. Withdrawers also arrive in a Poisson fashion with mean arrival rate of 14 per hour.

   (a) What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits?

   (b) What would be the effect if this could only be accomplished by increasing the service time to 35 minutes?   [16]

6. (a) Discuss what "Wilson Harris Simple EOQ".

   (b) A manufacturing company uses certain part at a constant rate of 4,000 units per year. Each unit costs Rs.2/- and the company personnel estimates that it costs Rs.50 to place an order, the carrying costs of inventory is estimated to be 20% per year, find the optimum size of each order and minimum yearly costs.   [6+10]

7. (a) Define Bellmen's principle of optimality.

   (b) Discuss about application of dynamic programming.   [8+8]

8. What are advantages of simulation? Explain Monte-Carlo simulation.   [16]

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$\boxed{\textbf{Set No. 4}}$

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1. (a) Define Operations Research. What are the developments of OR after world war II.?

   (b) Discuss the Advantages and Limitations of OR.   [8+8]

2. (a) With reference to the transportation problem define the following:

      i. Feasible solution
      ii. Basic feasible solution
      iii. Optimal solution.

   (b) Determine an initial basic feasible solution and optimal solution to the transportation problem given in figure 2b.   [6+10]

	I	II	III	IV	Supply
A	13	11	15	20	2,000
From B	17	14	12	13	6,000
C	18	18	15	12	7,000
Demand	3,000	3,000	4,000	5,000	15,000

Figure 2b

3. (a) State some of the simple replacement policies and give the average cost function for the same explaining your notations.

   (b) A factor has a large number of bulbs, all of which must be in working condition. The mortality of bulbs is given in the following table :

Week :	1	2	3	4	5	6
Proportion of bulbs failure :	0.10	0.15	0.25	0.35	0.12	0.03

   If a bulb fails in service, it cost Rs. 3.50 to replace; but if all the bulbs are replaced at a time it costs Rs. 1.20 each. Find the optimum group replacement policy.

                                                                        [6+10]

4. (a) Differentiate between strictly determinable games and non-determinable games.

   (b) With the help of an appropriate example establish the relationship between 'Game theory' and 'Linear Programming'.   [8+8]

5. A repair shop attended by a single mechanic has an average of 4 customers per hour who brings small appliances for repair. The mechanic inspects them for defects and quite often can fix them right away or otherwise render a diagnosis. This takes him 6 minutes on the average. Arrivals are Poisson and service time has the exponential distribution. Your are required to

   (a) Find the proportion of time during which the shop is empty.

   (b) Fid the probability of finding at least one customer in the shop.

   (c) The average number of customers in the system.

   (d) The average time, including service, spent by a customer. [16]

6. (a) Classify inventory.

   (b) Find the economic lot size, that associates with total cost and the length of time between two orders, given that the set-up cost is Rs.100, daily holding cost per unit of inventory is 5 paise and daily demand is approximately 30 units. [6+10]

7. A dealer has to dispose of certain goods within five weeks time. The marker process are fluctuating from week to week. It is estimated that the chances of getting Rs.2,000 for the whole stock and 45%, chances of getting Rs.2,500 are 35% and there are 20% chances that the goods may sell at Rs.3,000 . If the goods are not sold in the first four weeks, then they will have to be disposed of in the fifth week at the prevailing market price in that week. When should the stocks be sold? [16]

8. Define simulation. Explain about simulation languages. [16]

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