Code No: RT32031

(**R13**)

(**SET - 1**)

III B. Tech II Semester Regular Examinations, April - 2016
OPERATIONS RESEARCH
(Mechanical Engineering)

Time: 3 hours   Maximum Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
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PART –A

1	a)	Discuss the various phases in solving an OR problem.	[4M]
	b)	Explain the difference between a transportation problem and an assignment problem. Explain situations where an assignment problem can arise.	[4M]
	c)	Explain replacement situations giving an example for each of them.	[3M]
	d)	What do you understand by a queue? Give some important applications of queuing theory.	[3M]
	e)	Why is inventory maintained? Discuss it and give a classification of inventory models.	[4M]
	f)	What are the applications of dynamic programming problem? Explain.	[4M]

PART -B

2   Max $Z=3x_1+2x_2+5x_3$ [16M]
       Subject to the constraints
        $x_1+2x_2+x_3 \le 430$
        $3x_1+2x_3 \le 460$
        $x_1+4x_2 \le 420$ and $x_1,x_2,x_3 \ge 0$

3   a)   Determine the optimal solution to each of the following degenerate transportation   [10M]
          problem:

	D1	D2	D3	D4	D5	a_i
O1	4	7	3	8	2	4
O2	1	4	7	3	8	7
O3	7	2	4	7	7	9
O4	4	8	2	4	7	2
b_j	8	3	7	2	2	

     b)   What is no passing rule in sequencing algorithm? Explain the principle assumptions   [6M]
         made while dealing with sequencing problems.

4   a)   A computer contains 10,000 resistors. When any one of the resistor fails, it is   [10M]
         replaced. The cost of replacing a single resistor is Rs.10 only. If all the resistors are
         replaced at the same time, the cost per resistor would be reduced to Rs. 3.50. The
         percent surviving by the end of month t is as follows:

Month(t)	0	1	2	3	4	5	6
% surviving by the end of month	100	97	90	70	30	15	0

What is the optimum plan?

b) Explain how the theory of replacement is used in the problem of replacement of items that fail completely. [6M]

5 a) Solve the following (2 x 4) game. [10M]

B

	I	II	III	IV
I	2	2	3	-1
II	4	3	2	6

A

b) The XYZ company's quality control dept is managed by a single clerk, who takes on an average 5 minutes in checking parts of each of the machine coming for inspection. The machines arrive once in every 8 minutes on the average. One hour of the machine is valued at Rs15 and a clerk's time is valued at Rs.4 per hour. What are the average hourly queuing system costs associated with the quality control department? [6M]

6 a) A company uses annually 24,000 units of raw material which costs Rs. 1.25 per unit. Placing each order costs Rs. 22.50 and the carrying cost is 5.4% per year of the average inventory. Find the economic lot size and the total inventory cost (including cost of material). Should the company accept the offer made by the supplier of a discount of 5% on the cost price on a single order of 24,000 units? [10M]

b) What are the objectives that should be fulfilled by an inventory control system? [6M]

7 a) What are the prerequisites for a problem to be solved by dynamic programming? [8M]

b) A town contains six wards and they contain 170, 510, 640, 75, 250 and 960 houses respectively. Make a random selection of 8 houses using the tables of random numbers. Explain the procedure adopted by you. [8M]

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PART –A

1	a)	What are the applications of OR?	[4M]
	b)	Explain what you mean by a sequencing problem.	[4M]
	c)	Explain the methodology of solving replacement problems.	[3M]
	d)	Name a few applications of queuing in mechanical engineering.	[3M]
	e)	What are the basic assumptions involved in EOQ concept?	[4M]
	f)	Illustrate Bellman's principle of optimality with an example.	[4M]

PART -B

2   a)   Solve the following problem by Big-M method: [16M]

$\text{Min } Z = 5x_1 + 3x_2$

Subject to the constraints:

$$2x_1 + 4x_2 \leq 12$$
$$2x_1 + 2x_2 = 10$$
$$5x_1 - 2x_2 \geq 10$$
$$\text{and } x_1, x_2 \geq 0$$

3   a)   A company has six jobs which go through three machines X,Y and Z in the order   [10M]
XYZ. The processing time in minutes for each job on each machine is as follows:

Job							
Machine		1	2	3	4	5	6
	X	18	12	29	36	43	37
	Y	7	12	11	2	6	12
	Z	19	12	23	47	28	36

What should be the sequence of the jobs?

   b)   Write the LP formulation of a transportation problem.   [6M]

4   a)   A machine owner finds from his past records that the costs per year of maintaining a   [10M]
machine whose purchase price is Rs.6000 are as given below:

Year	1	2	3	4	5	6	7	8
Maintenance cost(Rs)	1000	1200	1400	1800	2300	2800	3400	4000
Resale price	3000	1500	750	375	200	200	200	200

Determine at what age is a replacement due?

   b)   In a store customers arrive in a Poisson stream with mean 60 per hour. The service   [6M]
time is exponential with mean of 0.005 hours. How many clerks should be available
if the expected waiting time in the system should be less than 10 minutes.

5   a)   Use dominance principle to simplify the rectangular game with the following payoff   [10M]
        matrix and then solve graphically.

Player A

		I	II	III	IV
Player B	1	18	4	6	4
	2	6	2	13	7
	3	11	5	17	3
	4	7	6	12	2

   b)   Show how a game can be formulated as a linear programming problem.   [6M]

6   Find the optimum order quantity for a product for which the price breaks are as   [16M]
    follows:

Quantity	Unit cost(Rs)
$0 \leq q1 < 500$	10.00
$500 \leq q2$	9.25

   The monthly demand for a product is 200 units, the cost of storage is 2% of unit cost
   and the cost of ordering is Rs.350.

7   a)   Write a detailed note on applications of simulation in manufacturing systems.   [8M]

   b)   Distinguish between mathematical models and simulation models.   [8M]

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PART –A

1	a)	Discuss the characteristics and the limitations of OR.	[4M]
	b)	State a transportation problem. When does it have a unique solution? Explain.	[4M]
	c)	What are the situations which make the replacement of items necessary?	[3M]
	d)	A game refers to a situation of business conflict. Discuss.	[3M]
	e)	What are the assumptions of the basic inventory model? How does each affect the model?	[4M]
	f)	What are limitations of dynamic programming problem?	[4M]

PART -B

2 a) Solve the following LP problem graphically: [16M]
        Minimize $Z=-6x_1-4x_2$
        Subject to the constraints:
        $2x_1+3x_2\geq30$
        $3x_1+2x_2\leq24$
        $x_1+x_2\geq3$ and $x_1,x_2\geq0$

3 a) A salesman has to visit five cities A,B,C,D and E. The distance (in hundred miles)   [10M]
        between the five cities are as follows:

|	A	B	C	D	E
A	---	7	6	8	4
B	7	---	8	5	6
C	6	8	---	9	7
D	8	5	9	---	8
E	4	6	7	8	---

If the salesman starts from city A and has to come city A, which route should he
select so that the total distance travelled is minimum?

   b) What are the assumptions involved in job sequencing problems?   [6M]

4 a) A factory has a large number of bulbs, all of which must be in working condition.   [10M]
        The mortality of bulbs is given in the following table:

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

If a bulb fails in service, it costs 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.

   b) What do you mean by "money value"? How do you count it?   [6M]
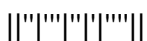
5 a) Two competitors A and B are competing for the same product. Their different   [10M]
       strategies are given in the following payoff matrix:

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

       Use dominance principle to find the the optimal strategies.

   b) On an average 96 patients per 24-hour day require the service of an emergency   [6M]
       clinic. Also on average, a patient requires 10 minutes of active attention. Assume
       that the facility can handle only one emergency at a time. Suppose that it costs the
       clinic Rs. 100 per patient treated to obtain an average servicing time of 10 minutes,
       and that each minute of decrease in this average time would cost Rs. 10 per patient
       treated How much would have to be budgeted by the clinic to reduce the average
       size of the queue from $1\frac{1}{3}$ to $\frac{1}{2}$ patient.

6 a) Find the optimal order quantity for a product for which the price breaks are as   [10M]
       follows:

Quantity	$0 \leq q1 < 50$	$50 \leq q2 < 100$	$100 \leq q3$
Unit cost(Rs)	10.00	9.00	8.00

       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.

   b) Distinguish between ABC and VED analyses.   [6M]

7   Solve the following linear programming problem by dynamic programming: [16M]
            Max Z= $3x_1 + x_2$ subject to the constraints
                $2x_1 + x_2 \leq 6$
                $X_1 \leq 2$
                $X_2 \leq 4$ and $x_1, x_2 \geq 0$

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PART –A

1	a)	What are the various types of OR models? Explain.	[4M]
	b)	What do you mean by non-degenerate basic feasible solution of a transportation problem?	[4M]
	c)	Discuss briefly the various types of replacement problems.	[3M]
	d)	What is a rectangular game? Define pure strategy and mixed strategy in a game.	[3M]
	e)	What are the advantages and disadvantages of having inventories?	[4M]
	f)	State and explain Bellman's principle of optimality in dynamic programming.	[4M]

PART -B

2　a)　Solve the following LP problem by two phase method:　　　　　　　　　[16M]

　　　Max $Z=5x_1+8x_2$
　　　Subject to the constraints:
　　　$3x_1+2x_2 \geq 3$
　　　$x_1+4x_2 \geq 4$
　　　$x_1+x_2 \leq 5$　and $x_1,x_2 \geq 0$

3　a)　We have five jobs each of which must go through two machines in the order AB, 　[8M]
　　　processing times are given in the table below:

Job No	1	2	3	4	5
Machine A	10	2	18	6	20
Machine B	4	12	14	16	8

Determine a sequence for the five jobs that will minimize the total elapsed time.

　b)　Solve the following cost minimizing transportation problem.　　　　　　　[8M]

	D1	D2	D3	D4	D5	D6	Available
O1	2	1	3	3	2	5	50
O2	3	2	2	4	3	4	40
O3	3	5	4	2	4	1	60
O4	4	2	2	1	2	2	30
Required	30	50	20	40	30	10	180

4　a)　A truck owner finds from his past records that the maintenance costs per year of a 　[10M]
　　　truck whose purchase price is Rs. 8000, are given below:

Year	1	2	3	4	5	6	7	8
Maintenance cost(Rs)	1000	1300	1700	2200	2900	3800	4800	6000
Resale price(Rs)	4000	2000	1200	600	500	400	400	400

Determine at what tine it is profitable to replace the truck.

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    b)   Explain with examples the failure mechanism of items.   [6M]

5   a)   A TV repairman finds that the time spent on his jobs has an exponential distribution   [8M]
           with mean 30 minutes. If he repairs sets in the order in which they come in, and if the
           arrival of sets is approximately poisson with an average rate of 10 per 8 hour day,
           what is repairman's expected idle time each day? How many jobs are ahead of the
           average set just brought in?

    b)   Two players A and B match coins. If the coin matches, then A wins one unit of value,   [8M]
           if the coins do not match, then B wins one unit of value. Determine optimum
           strategies for the players and the value of the game.

6   a)   An aircraft uses rivets at an approximately constant rate of 5,000 kg per year. The   [10M]
           rivets cost Rs.20 per kg and the company personnel estimate that it costs Rs. 200 to
           place an order, and the carrying cost of inventory is 10% per year.
           (i) How frequently should orders for rivets be placed, and what quantities should be
              ordered for?
           (ii) If the actual costs are Rs. 500 to place an order and 15% for carrying cost, the
              optimum policy would change. How much is the company losing per year because
              of imperfect cost information?

    b)   Discuss briefly various types of inventory models.   [6M]

7   a)   Discuss the various types of simulation models.   [8M]

    b)   Write a short note on the essential features of Simulation Languages.   [8M]

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