Code No: RT32031 **R13** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April -2018

OPERATIONS RESEARCH

(Mechanical Engineering)

Time: 3 hours Max. 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) What do you mean by i) Feasible solution ii) Optimal solution iii) Basic Variables iv) Artificial variables. [4M]

b) Describe the difference between a transportation problem and an assignment problem. [3M]

c) Explain the types of replacement problems. [4M]

d) Discuss briefly the main characteristics of a queuing system. [3M]

e) What are the functions of inventory management? Explain. [4M]

f) What are the properties of random numbers? [4M]

PART-B

2 a) Explain any four applications of Operations Research in mechanical engineering. [8M]

b) Solve the following LP problem: [8M]

Min $Z = 3x_1+5x_2$

Subject to $-3x_1+4x_2 \leq 12$

$2x_1-x_2 \geq -2$

$2x_1+3x_2 \geq 12$

$x_1 \leq 4, x_2 \geq 2$

$x_1, x_2 \geq 0$

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

b) A machine operator processes five types of items on his machine each week and must choose a sequence for them. The set-up cost per change depends on the items presently on the machine and the set-up to be made according to the following table: [10M]

	To item					
From item		A	B	C	D	E
	A	----	4	7	3	4
	B	4	----	6	3	4
	C	7	6	----	7	5
	D	3	3	7	----	7
	E	4	4	5	7	----

If he processes each type of item once and only once in each week, how should he sequence the items on his machine in order to minimize the total set-up cost?

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4 a) A firm is considering replacement of equipment, whose intital cost is Rs. 4,000 and the scrap value is negligible at the end of any year. Based on experience, it was found that the maintenance cost is zero during the first year and it increases by Rs. 200 every year thereafter. [10M]
i) When should the equipment be replaced if "i" = 0%?
ii) When should the equipment be replaced if "i" = 12%?

b) What are the advantages and applications of group replacement policy? [6M]

5 a) Solve the following game and determine the value of the game: [8M]

	B	
A	4	-4
	-4	4

b) Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call assumed to be distributed exponentially with mean 3 minutes. Then, [8M]
(i) What is the probability that a person arriving at the booth will have to wait?
(ii) What is the average length of the queue that form from time to time?
(iii)The telephone department will install a second booth when convinced that an arrival would expect to have to wait at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth?

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

Quantity	Unit Cost (Rs.)
$0 \le q_1 \le 800$	Rs. 1.00
$800 \le q_2$	Rs. 0.98

The yearly demand for the product is 1600 units per year, cost of placing an order is Rs 5, the cost of storage is 10% per year.

b) Write about the important features of VED analysis. [6M]

7 Illustrate how you apply simulation for queuing problems. Explain with an example. [16M]

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PART-A

1 a) How can operations research models be classified? Explain. [4M]
b) Explain the applications of job sequencing. [3M]
c) What is money value, Explain with an example [4M]
d) Give some important applications of queuing theory in mechanical engineering. [3M]
e) Write the equation for EOQ. What are the assumptions involved? [4M]
f) What are the limitations of simulation? [4M]

PART-B

2 Max $Z = x_1+2x_2+x_3$ [16M]
Subject to $2x_1+x_2-x_3 \geq -2$
$-2x_1+x_2-5x_3 \leq 6$
$4x_1+x_2+x_3 \leq 6$
$x_1, x_2, x_3 \geq 0$

3 a) We have five jobs each of which must go through the machines A, B and in the order ABC. Determine the sequence that will minimize the total elapse time: [12M]

Job No	1	2	3	4	5
M/C A	5	7	6	9	5
M/C B	2	1	4	5	3
M/C C	3	7	5	6	7

Also determine the idle time of each machine.

b) Why is not Simplex method applied directly to solve the transportation problems? [4M]

4 A computer contains 10000 resistors. When any one of the resistor fails, it is replaced. The cost of replacing a single resistor is Re.1 only. If all resistors are replaced at the same time, the cost per resistor would be reduced to 35 paise. The percent surviving by the end of month t is as follows: [16M]
What is the optimum plan?

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

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5 a) Solve the following game: [8M]

		Player B			
		I	II	III	IV
Player A	I	6	8	3	13
	II	4	1	5	3
	III	8	10	4	12
	IV	3	6	7	12

Determine the optimum strategies for the players and the value of the game.

b) In a supermarket, the average arrival rate of customer is 10 every 30 minutes following poisons process. The average time taken by a cashier to list and calculate the customers purchase is 2.5 minutes following exponential distribution. What is the probability that the queue length exceeds 6? What is the expected time spent by a customer in the system? [8M]

6 a) Find the optimum order quantity for a product for which the price breaks are as follows: [8M]

Quantity	Unit Cost (Rs)
$0 \le q_1 \le 100$	Rs 20 per unit
$100 \le q_2 < 200$	Rs 18 per unit
$200 \le q_3$	Rs 16 per unit

The monthly demand for the product is 400 units. The storage cost is 20% of the unit cost of the product and the cost of the ordering is Rs25.

b) Write the important features of ABC analysis. [8M]

7 Minimize $Z = Y_1^2 + Y_2^2 + Y_3^2$ [16M]
Subject to $Y_1 + Y_2 + Y_3 \ge 15$,
$Y_1, Y_2, Y_3 \ge 0$

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PART-A

1 a) What are the various phases in OR? Explain. [4M]
b) Explain no passing rule in a sequencing algorithm. [3M]
c) Discuss money value, present value and discount rate. [4M]
d) Describe the fundamental components of a queuing process. [3M]
e) Why is inventory maintained? Explain. [4M]
f) State and explain Bellman's principle of optimality. [4M]

PART-B

2 Use two-phase method to solve the following LPP: [16M]
Maximize $Z=2x_1+x_2+x_3$
Subject to $4x_1+6x_2+3x_3 \leq 8$
$3x_1-6x_2-4x_3 \leq 1$
$2x_1+3x_2-5x_3 \geq 4$
$x_1, x_2, x_3 \geq 0$

3 a) For the transportation problem given by the following tableau, find an initial basic feasible solution by the North – West corner method and then find an optimal solution [10M]

			Supply
9	15	12	25
6	8	13	15
9	3	11	20
Demand 21	14	25	

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

4 A truck is priced at Rs.60000 and running costs are estimated at Rs.6000 for each of the first four years, increasing by Rs.2000 per year in the fifth and subsequent years. If the money is worth 10% per year, when should the truck be replaced. Assume that the truck will eventually be sold for scrap at a negligible price. [16M]

5 a) For the game with the following payoff matrix, determine the optimal strategy and the value of the game: [8M]

	B	
A	6	-3
	-3	0

b) Discuss the principle and rules of dominance to reduce the size of payoff matrix. [8M]

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6 a) Derive the equation for EOQ when shortages are not allowed. [8M]

b) The annual requirement for a product is 3000 units. The ordering cost is Rs 100 per order. The cost per unit is Rs 10. The carrying cost per unit per year is 30% of the unit cost. i) Find the EOQ [8M]
ii) by using better organizational methods the ordering cost per order is brought down to Rs 80 per order, but the same quantity as determined above were ordered
iii) If a new EOQ is found by using the ordered cost as Rs 80, what would be further savings in cost?

7 a) State the Bellman's principle of optimality and explain by an illustrative example how it can be used to solve a multi stage decision problem [10M]

b) State the advantages and limitations of simulation [6M]

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PART-A

1 a) Discuss the significance and scope of Operations Research. [4M]
b) How do we solve unbalanced transportation problem. [3M]
c) Explain briefly various types of replacement problems. [4M]
d) Discuss 'minimax criterion' as applied to the theory of games. [3M]
e) Explain the following with regard to inventory model: [4M]
i) Lead time ii) quantity discounts
f) What are the essential characteristics of dynamic programming problem? Explain. [4M]

PART-B

2 Solve the following LPP: [16M]
Minimize $Z= 4x_1+3x_2+x_3$
Subject to $x_1+2x_2+4x_3 \geq 12$
$3x_1+2x_2+x_3 \geq 8$
$x_1, x_2, x_3 \geq 0$

3 a) Find the optimal solution for the following transportation problem. [8M]

		Destination				
		D_1	D_2	D_3	D_4	Supply
Origin	O_1	11	13	17	14	250
	O_2	16	18	14	10	300
	O_3	21	24	13	10	400
	Demand	200	225	275	250	950

b) Write the algorithm for two jobs through "m" machines. [8M]

4 The following failure rates have been observed for a certain type of light bulb. [16M]

End of week	1	2	3	4	5	6	7
Probability failure to date	0.05	0.15	0.25	0.46	0.68	0.88	1.00

The replacement of an individual bulb on failure cost Rs 1.25. The cost of group replacement is 80paise per bulb. Determine the better one among the individual and group replacement policies.

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5 a) Solve graphically: [8M]

1	-3
3	5
-1	6
4	1
2	2
-5	0

b) Vehicles are passing through a toll gate at the rate of 70 per hour. The average time to pass through the gate is 45 seconds. The arrival rate and service rate follow poisson distibution. There is a complaint that the vehicles wait for a long duration. The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 35 seconds if the idle time of the toll gate is less than 9% and the average queue length at the gate is more than 8 vehicle, check whether the installation of the second gate is justified? [8M]

6 a) Explain the EOQ problem with one piece break. [8M]

b) When do you apply selective inventory techniques? Explain any one such technique with its merits and demerits. [8M]

7 Solve the following LPP by dynamic programming: [16M]

Max Z =3x+2y

Subject to $x+y \leq 300$

$2x+3y \leq 800$

$x,y \geq 0$

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