

III B. Tech I Semester Regular Examinations, October/November - 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. Answer **ALL** the question in **Part-A**3. Answer any **FOUR** Questions from **Part-B**~~~~~
PART – A

- 1 a) Write the classification of OR models. [2M]
- b) Explain the use of vogel's approximate method? [3M]
- c) Explain replacement situations giving an example for each of them. [2M]
- d) What is a rectangular game? Define pure strategy and mixed strategy in a game. [2M]
- e) What are the types of inventory? [2M]
- f) What is meant by Monte Carlo simulation? [3M]

PART – B

- 2 What do you mean by LPP? What are its limitations? Use penalty (or Big-M) method to maximize $z = 3x_1 - x_2$ [14M]
 Subject to the constraints
 $2x_1 + x_2 \geq 2$; $x_1 + 3x_2 \leq 3$; $x_2 \leq 4$ $x_1, x_2 \geq 0$.
- 3 a) Find the optimum solution to the transportation problem given in the Table for which the cost, origin-availabilities, and destination-requirements are given. [7M]

	D1	D2	D3	D4	Supply
O1	5	3	6	2	19
O2	4	7	9	1	37
O3	3	4	7	5	34
Demand	16	18	31	25	90

- b) Six jobs go first over Machine-I and then over Machine-II. The orders of completion of jobs have no significance. The following gives the machine times in hours for six jobs and the two machines. [7M]
 Find the

Job	1	2	3	4	5	6
Machine I	5	9	4	7	8	6
Machine II	7	4	8	3	9	5

Optimal total time and the idle times of the machine.

- 4 a) Find the cost period of individual replacement of an installation of 300 lighting bulbs, given the following: [7M]
 - i) Cost of replacing individual bulb is Rs. 3
 - ii) Conditional probability of failure is given below:

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

- b) Explain the replacement procedure for the items that deteriorate with time with an example. [7M]
- 5 a) Solve the following game graphically. [7M]
- | | Player B | |
|--------------|----------|----|
| Play
er A | 1 | 2 |
| | 5 | 4 |
| | -7 | 9 |
| | -4 | -3 |
| | 2 | 1 |
- b) Write the assumptions made in game theory. [7M]
- 6 a) A manufacturer purchases items in lots of 800 units which is a four months requirement. The cost per unit is Rs. 100 and the ordering cost is Rs. 120 per patch order. The inventory carrying cost is estimated as 20% of the average inventory investment. i) Determine the annual variable cost managing the inventory. ii) How much saving can be obtained from the EOQ purchases? [8M]
- b) Describe the EOQ problem with one price break. [6M]
- 7 a) Explain the principal features of simulation languages. [6M]
- b) Apply Dynamic programming to $\text{Max } Z = 2x_1 + 3x_2$ [8M]
 subjected to $x_1 + 2x_2 \leq 4$
 $2x_1 + x_2 \leq 3$ and $x_1, x_2 \geq 0$

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- 1 a) What are the limitations of LP problem? [2M]
- b) Give the mathematical formulation of an assignment problem [3M]
- c) Discuss briefly the various types of replacement problems. [2M]
- d) Give some important applications of queuing theory in industries. [2M]
- e) Describe the basic characteristics of an inventory system. [3M]
- f) Distinguish between mathematical models and simulation models. [2M]

PART – B

- 2 Maximize $Z=5x_1-4x_2+3x_3$ Subject to [14M]

$$2x_1+x_2-6x_3=20$$

$$6x_1+5x_2+10x_3 \leq 76$$

$$8x_1-3x_2+6x_3 \leq 50$$

$$x_1, x_2, x_3 \geq 0$$

- 3 a) Briefly explain the Hungarian Method procedure with example. Also write the assumptions. [8M]
- b) What is degeneracy? How do you overcome degeneracy in transportation problems? [6M]

- 4 a) A machine owner finds from his past records that the costs per year of maintaining a machine whose purchase price is Rs. 6000/- are as given below. [7M]

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

Determine at what age a replacement is due.

- b) Briefly explain what you mean by “individual and group replacement policy”. [7M]
- 5 a) In a game matching coins with two players suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and losses $\frac{1}{2}$ unit of value when there are one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of game to A. [7M]

- b) Solve the following game using dominance principle.

[7M]

		Player B			
Player A		1	2	3	4
	I	19	6	7	5
	II	7	3	14	6
	III	12	8	18	4
	IV	8	7	13	-1

- 6 a) What are costs that are involved in carrying inventory? Explain them in detail. [7M]
 b) A small firm producing automobile brake linings estimates the steel requirements for the next year's production at 6000 Kg. The cost of carrying steel in inventories works out to Rs 1 per Kg. per month. The cost of ordering works out at Rs 100 per order. If the cost per kg of steel is Rs 100, find out the economic order quantity, the number of orders per year, and total cost incurred by the firm for one year. [7M]
- 7 A. distance network consists of eleven nodes which are distributed as shown in figure 1. Find the shortest path from node 1 to node 11 and also the corresponding distances. [14M]

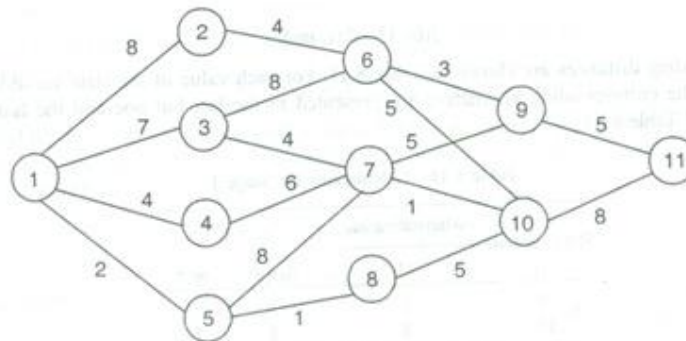


Figure .1 Distance network.

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3. Answer any **FOUR** Questions from **Part-B**

PART – A

- 1 a) What is its significance in simplex method of solving LPP? [2M]
- b) Give the mathematical formulation of transportation problem. [2M]
- c) Explain the methodology of solving replacement problems. [2M]
- d) What is a rectangular game? [2M]
- e) Derive the mathematical equation for EOQ. What are the assumptions involved? [3M]
- f) What is dynamic programming? [3M]

PART – B

- | | | | |
|---|----|--|------|
| 2 | a) | A company is manufacturing two different types of products, A and B. Each product has to be processed on two machines M_1 and M_2 , Product A requires 2 hours on machine M_1 and 1 hour on machine M_2 , product B requires 1 hour on machine M_1 and 2 hours on machine M_2 . The available capacity of machine M_1 is 104 hours and that of machine M_2 is 76 hours. Profit per unit for product A is Rs.6 and that for B is Rs.11. Calculate i) Formulate the problem ii) Find out the optimal solution by Simplex method. | [8M] |
| | b) | Briefly explain the applications of Operation Research. | [6M] |
| 3 | a) | What is sequencing problem? Explain the following terms in context of sequence problems: i) Total elapsed time and Idle time ii) no passing rule iii) processing order. | [8M] |
| | b) | Write the LP formulation of a transportation problem. | [6M] |

- 4 The failure rates of 1000 street bulbs in a colony are summarized in following table [14M]

	Failure Rates of Street Bulbs					
End of month	1	2	3	4	5	6
Probability of failure to date	0.05	0.20	0.40	0.65	0.85	1.00

The cost of replacing an individual bulb is Rs.60. If all the bulbs are replaced simultaneously it would cost Rs. 25 per bulb. Any one of the following two options can be followed to replace the bulbs.

- i) Replace the bulbs individually when they fail (individual replacement policy).
- ii) Replace all the bulbs simultaneously at fixed intervals and replace the individual bulbs as and when they fail in service during the fixed interval (group replacement policy). Find out the optimal replacement policy, i.e. individual replacement policy or group replacement policy If group replacement policy is optimal, then find at what equal intervals should all the bulbs be replaced?

- 5 a) The payoff matrix of a game is given. Find the solution of the game to the player A and B. [7M]

	Player B					
Player A		I	II	III	IV	V
	I	-2	0	0	5	3
	II	3	2	1	2	2
	III	-4	-3	0	-2	6
	IV	5	3	-4	2	-6

- b) Explain the theory of dominance in the solution of rectangular games. [7M]
- 6 Determine a decision rule using the basic purchasing EOQ model for annual demand of 20,000 units, ordering cost of Rs.200 per order and carrying cost of 10% per year. The basic price is Rs.8.00 per unit. This price is in effect of all orders of less than 5000 units. Orders for 5000 or more but less than 10000 units may be purchased for Rs.7.50 per unit. Orders for 10000 or more units may be purchased for Rs.7.25 per unit. [14M]
- 7 a) Discuss the types of simulation models. [7M]
- b) Solve the following problem by using dynamic programming: [7M]

$$\text{Max. } Z = 2x_1 + 9x_2$$

subject to

$$2x_1 + x_2 \leq 25$$

$$x_2 \leq 11$$

$$x_1, x_2 \geq 0.$$

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PART – A

- | | | | |
|---|----|---|------|
| 1 | a) | State the general linear programming problem (LPP) and put it in the standard form. | [3M] |
| | b) | What is meant by an optimality test in a transportation problem? | [2M] |
| | c) | What are the situations which make the replacement of items necessary? | [2M] |
| | d) | Name a few applications of queuing in mechanical engineering. | [2M] |
| | e) | Explain the significance of EOQ. | [2M] |
| | f) | What are the demerits of dynamic programming? | [3M] |

PART – B

- 2 a) 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? [7M]
- b) Minimize $Z = x_1 - 3x_2 + 2x_3$, [7M]
Subject to: $3x_1 - x_2 + 3x_3 \leq 7$
 $-2x_1 + 4x_2 \leq 12$
 $-4x_1 + 3x_2 + 8x_3 \leq 10$, and $x_1, x_2, x_3 \geq 0$ Solve the problem by using simplex method.

- 3 Consider the problem of assigning five operators to five machines. The assignment [14M]
costs are given in below table.

	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

Operator A cannot be assigned to machine M_3 and operator C cannot be assigned to machine M_4 . Find the optimum assignment schedule.

- 4 a) Alpha Castings Private Limited, a small scale industry purchases a generator for Rs. 20,000. The operation cost is Rs. 2000 during the first year of its operation and it increases by Rs. 1000 every year thereafter. The maintenance cost is Rs. 200 during the first year of its operation and it increases by Rs. 100 every year thereafter. The purchase of this generator is through an interest free loan sanctioned for this company by Small Scale Industrial Development Corporation. Find the economic life of the generator. [7M]

- b) The initial cost of an item is Rs.20,000 and maintenance and running cost (in Rs) for different years are given below: [7M]

Year	1	2	3	4	5	6	7
Running Cost	3000	3500	4500	5500	6500	8500	10500

What is the replacement policy to be adopted If the capital worth is 15% and there is no salvage value?

- 5 a) Solve the following game using dominance principle. [8M]

		Player B			
		1	2	3	4
Player A	I	19	6	7	5
	II	7	3	14	6
	III	12	8	18	4
	IV	8	7	13	-1

- b) Explain the following: (i) Saddle point (ii) Two-person zero -sum game. [6M]
- 6 a) Annual demand for an item is 6000 units. Ordering cost is Rs. 600 per order. Inventory carrying cost is 18% of the purchase price/unit/year. The price breakups are as shown below. [7M]

Quantity	Price (in Rs.) Per unit
$0 \leq Q_1 < 2000$	20
$2000 \leq Q_2 < 4000$	15
$4000 \leq Q_3$	9

Find the optimal order size.

- b) Derive the mathematical equation for EOQ. What are the assumptions involved? [7M]
- 7 a) Solve the following linear programming problem by dynamic programming approach. Maximize $Z = 2x_1 + 5x_2$,
Subject to the constraints
 $2x_1 + x_2 \leq 43$
 $2x_2 \leq 46$
 $x_1 \geq 0, x_2 \geq 0$. [10M]
- b) Explain briefly the advantages and the disadvantages of simulation. [4M]
