(6 pages)

DECEMBER 2023 **P/ID 77931/RMB2G**

Time : Three hours Maximum : 80 marks

PART A — ($10 \times 2 = 20$ marks)

Answer any TEN questions.

1. Define operation research.

2. Enumerate the essentials of operation Research.

3. Mention the steps in LP model.

4. Define Artificial variable.

5. State the steps in finding Least cost solution in Stepping stone method.

6. How do you recognize optimality in the simplex method?

7. How are the maximization problems solved using transportation model?

8. What is the "best strategy" on the basis of minimax criterion of optimality?

9. When do you say that the game is fair? Give an example for it.

10. What are the assumptions made in solving sequencing problems?

11. What are the situations which make the replacement of item necessary?

12. What is critical path method?

PART B — ($5 \times 6 = 30$ marks)

Answer any FIVE questions.

13. What areas of Operations Research have made a significant notes impact on decision-making process? Why is it important to keep an open mind in utilizing Operations Research techniques?

14. Consider a small plant which makes 2 types of automobile parts say A and B. It buys castings that are machined, bored and polished. The capacity of machining is 25 per hour for A and 40 hours for B, capacity of boring is 28 per hours for A and 35 per hour for B, and the capacity of polishing is 35 per hour A and 25 hour of B. Casting for part A costs Rs.2 each and for B they cost Rs.3 each. They sell for Rs.5 and Rs.6 respectively. The three machines have running costs of Rs.20, Rs.14 and Rs.17.50 per hour. Assuming that any combination of parts A and B can be sold, what product mix maximizes profit?

15. Use simplex method to solve:

$$\begin{aligned} \textit{Minimize}: \quad & Z = 14x_1 + 13x_2 + 11x_3 + 13x_4 + \\ & 13x_5 + 12x \\ \textit{Subject to} \quad & x_1 + x_2 + x_3 = 1200 \\ & x_4 + x_5 + x_6 = 1000 \\ & x_1 + x_4 = 1000 \\ & x_2 + x_5 = 700 \\ & x_3 + x_6 = 500 \end{aligned}$$

With all variables non-negative.

16. A state has three power plants with generating capacities of 30, 40 and 25 million KWH that supply electricity to three cities located in the same state. The demand requirements (maximum) of the three cities are 35, 40 and 20 million KWH. The distribution cost ('in thousand) per million unit for the three cities are given in the table below:

	City		
	60	75	45
Plant	35	35	40
	55	50	45

(a) Formulate the problem as a transportation model.

(b) Determine an economical distribution plan.

(c) If the demand is estimated to increase by 15%, what is your revised plan?

(d) If the transmission loss of 5% is considered, determine the optimal plan

17. Describe the method of drawing minimum number of lines in the context of assignment problem.

18. Explain the following: (a) Saddle point (b) Pay-off matrix (c) Rectangular games (d) Optimal strategy (e) Minimax principle (f) Value of a two-person-zero-sum game.

19. XYZ Co. buys in lots of 2,000 units which is only 3 months supply. The cost per unit is' 125 and the order cost is '250. The inventory cost is 20% of unit value. How much money can be saved by using Economic Order Quantity?

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

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

21. Determine which of the following two-person zero-sum games are strictly determinable and fair. Give optimum strategies for each player in case of strictly determinable games:

(a) Player B

$$\text{Player A} \begin{bmatrix} 0 & 2 \\ -1 & 4 \end{bmatrix}$$

(b) Player B

$$\text{Player A} \begin{bmatrix} -3 & 1 \\ 3 & -1 \end{bmatrix}$$

22. Use two-phase simplex method to solve the problem:

Min. $Z = x_1 - 2x_2 - 3x_3$

Subject to the constraints:

$-2x_1 + x_2 + 3x_3 = 2$

$2x_1 + 3x_2 + 4x_3 = 1$

$x_1, x_2, x_3 \geq 0$

23. A company is producing a single product and selling it through five agencies situated in the different cities. All of a sudden, there is a demand for the product in five more cities that do not have any agency of the company. The company is faced with the problem of deciding on how to assign the existing agencies to dispatch the product to the additional cities in such a way that the travelling distance is minimized. The distances (in km) between the surplus and the deficit cities are given in the following distance matrix:

		Deficit City			
	160	130	175	190	200
	135	120	130	160	175
Surplus City	140	110	155	170	185
	50	50	80	80	110
	55	35	70	80	105

Determine the optimum assignment schedule.

24. In this problem, a patient visits the doctor to get treatment for ill health. The doctor examines the patient and advises him to consume at least 40 units of vitamin A and 50 units of vitamin B daily for a specified time period. He also advises the patient that to get vitamin A and vitamin B he has to drink tonic X and tonic Y that have both vitamin A and vitamin B in a proportion. One unit of tonic X consists 2 units of vitamin A and 3 units of vitamin B and one unit of tonic Y consists of 4 units of vitamin A and 2 units of vitamin B. These tonics are available in medical shops at a cost of Rs.3.00 and Rs.2.50 per unit of X and Y respectively. Now the problem of patient is how much of X and how much of Y is to be purchased from the shop to minimise the total cost and at the same time he can get required amounts of vitamins A and B.