

MBCP 2004

M.B.A. DEGREE EXAMINATION, MAY 2026.

Second Semester

Common

OPERATIONS RESEARCH

(2023 Regulation)

Time : Three hours

Maximum : 75 marks

PART A — (5 × 4 = 20 marks)

Answer any FIVE questions.

1. List out and explain any five applications of operations research in government and public sector.
2. A person wants to decide the constituents of a diet which will fulfill his daily requirements of protein, fats and carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The nutrients per unit of these foods are given below

Formulate LP model for the given problem.

Food type	Proteins	Fats	Carbohydrates	Cost per unit(Rs.)
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	7	65
Nutrient Needed	800	200	700	

3. A firm produces three products. These products are processed on three different machines. The time required for manufacturing one unit of each of the three products and the daily capacity of the three machines are given in the table below :

Machine	Time	Per	Unit (minutes)	Machine capacity
	Product 1	Product 2	Product 3	(Minutes per day)
M1	2	3	2	440
M2	4	—	3	470
M3	2		—	430

It is required to determine the daily number of units to be manufactured for each product. The profit per unit of Product 1 is Rs.4, Product 2 is Rs.3 and Product 3 is Rs.6. It is assumed that all the quantities produced are consumed (sold) in the market. You are required to formulate Linear Programming (LP) model for the given problem.

4. Develop an initial basic feasible solution for the following problem using northwest corner method

Source	D1	D2	D3	D4	SQTY
S1	3	1	7	4	300
S2	2	6	5	9	400
S3	8	3	3	2	500
DQTY	250	350	400	200	1200

5. Explain some of the most common inventory management methods.
6. The following table gives the activities in a construction project and other relevant information.

Activity	1-2	1-3	2-3	2-4	3-4	4-5
Duration (days)	20	25	10	12	6	10

- (a) Draw the network for the project
- (b) Find the critical path and the project duration
- (c) Find the total float for each activity.

7. Using minimax criterion find the optimal strategies for the players in the game

	B1	B2	B3	B4	B5
A1	8	10	13	16	9
A2	7	12	6	15	10
A3	9	18	9	13	25
A4	4	9	8	20	6

8. A TV repairman finds that the time spent on his job has an exponential distribution with mean of 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 .
- (a) How many jobs are ahead of the set just bought in?
 - (b) What is the repairman's expected idle time each day?

PART B — (5 × 8 = 40 marks)

Answer any FIVE questions.

9. Summarize the applications of operations research in business.
10. Solve the following problem by graphical method
 Maximize $Z = 5x + 8y$
 Subject to the constraints
 $3x + 2y \leq 36$
 $x + 2y \leq 20$
 $3x + 4y \leq 42$
 and $x \geq 0, y \geq 0$.
11. Develop an initial basic feasible solution to the following transportation problem using Vogels Approximation Method.

Source	D1	D2	D3	D4	Supply
S1	21	16	15	3	11
S2	17	18	14	13	13
S3	32	27	18	41	19
Demand	6	10	12	15	43

12. A company has 4 workers (W1, W2, W3, W4) and needs to assign them to 4 different tasks (T1, T2, T3, T4). Each worker can be assigned to only one task; and each task must be assigned to exactly one worker. The cost (in man-hours) required for each worker to complete each task is given in the table below.

The objective is to minimize the total man-hours required for completing all tasks.

	T1	T2	T3	T4
W1	9	2	7	8
W2	6	4	3	7
W3	5	8	1	8
W4	7	6	9	4

Determine the optimal assignment and calculate the minimum total cost (in man-hours).

13. Calculate the total float, free float and independent float for the project whose activities are given below.

Activity	1-2	1-3	1-5	2-3	2-4
Duration	8	7	12	4	10
Activity	3-4	3-5	3-6	4-6	5-6
Duration	3	5	10	7	4

14. A telecommunications company is planning to lay fiber optic cables to connect 7 communication towers (labeled A through G) in a region. To minimize the installation cost, the company must determine a network that connects all towers with the minimum total cable length and no cycles—i.e., a Minimum Spanning Tree.

The table below shows the distances (in kilometers) between towers that can be directly connected. Not all towers are directly connected to each other

Distance Table (in km)

	A	B	C	D	E	F	G
A	—	2	3	—	—	—	—
B	2	—	1	4	—	—	—
C	3	1	—	5	6	—	—
D	—	4	5	—	2	3	—
E	—	—	6	2	—	4	5
F	—	—	—	3	4	—	2
G	—	—	—	—	5	2	—

- (a) Draw the final spanning tree and calculate the total cable length required.
- (b) Justify why this tree represents the most cost-effective way to connect all towers.

15. Following is the pay off matrix for Player A. Use Dominance Property to obtain optimum strategies for both the players. Find the value of the game.

	B1	B2	B3	B4	B5
A1	2	4	3	8	4
A2	5	6	3	7	8
A3	6	7	9	8	7
A4	4	2	8	4	2

16. Given the following information :

- machine break down at the average rate of 3 per hour
- The break down follows Poisson process
- Cost of idle machine hour is Rs. 10
- Repairman A charges Rs. 5 per hour and services at the rate of 4 per hour.
- Repairman A charges Rs. 7 per hour and services at the rate of 6 per hour.

Assuming the work shift for 8 hours which repairman should be hired?

PART C — (1 × 15 = 15 marks)

Answer the following.

(Compulsory)

17. Case Study :

Skyhigh Airlines, a regional carrier, faced operational inefficiencies due to poor scheduling, leading to frequent delays, high fuel costs, and low customer satisfaction. The airline's existing scheduling system was unable to account for various constraints, such as crew availability, aircraft maintenance requirements, and fluctuating passenger demand, resulting in suboptimal flight schedules.

To overcome these challenges, SkyHigh Airlines turned to Operations Research (OR) techniques. The airline implemented a combination of integer programming and network optimization models to develop more efficient flight schedules. These models considered multiple factors, including crew scheduling, aircraft routing, and maintenance windows, to minimize delays and reduce operational costs.

The OR-based scheduling system allowed SkyHigh Airlines to optimize its flight network, ensuring better alignment with passenger demand while maintaining compliance with regulatory requirements. The airline also improved crew utilization and reduced the need for costly last-minute changes, leading to more reliable operations.

As a result of these OR applications, SkyHigh Airlines achieved a 15% reduction in operational costs, a significant decrease in flight delays, and a marked improvement in customer satisfaction. The airline also enhanced its competitiveness in the market by offering more reliable and cost-effective services.

Questions :

- (a) How did Operations Research help SkyHigh Airlines reduce operational costs and improve customer satisfaction?
- (b) What challenges might SkyHigh Airlines face in maintaining optimized flight schedules over time?
- (c) How could SkyHigh Airlines further leverage OR techniques to enhance other aspects of its operations?