

6/MTH-353 Syllabus-2023

2026

(May-June)

FYUP : 6th Semester Examination

MATHEMATICS

(Operation Research)

(MTH-353)

Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks
for the questions.*

Answer **four** questions, taking **one** from each Unit.

UNIT—I

1. (a) Define the following terms : 2+2+2=6

- (i) Integer programming problem
- (ii) Pure integer programming problem
- (iii) Mixed integer programming problem

(2)

- (b) Find the optimal integer solution to the following LPP :

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Maximize $Z = x_1 + 4x_2$
subject to the constraints

$$2x_1 + 4x_2 \leq 7$$

$$5x_1 + 3x_2 \leq 15$$

$$x_1, x_2 \geq 0$$

and are integers.

2. (a) Describe Gomory's method of solving an all-integer linear programming problem.

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- (b) Use branch and bound method to solve the following LPP :

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Maximize $Z = 7x_1 + 9x_2$
subject to the constraints

$$-x_1 + 3x_2 \leq 6$$

$$7x_1 + x_2 \leq 35$$

$$x_2 \leq 7$$

$$x_1, x_2 \geq 0$$

and are integers.

UNIT—II

3. (a) What is an assignment problem? Describe the mathematical formulation of an assignment problem.

2+5=7

(3)

- (b) A company wishes to assign 3 jobs to 3 machines in such a way that each job is assigned to some machine and no machine works on more than one job. The cost of assigning job i to machine j is given by the matrix below (ij th entry) :

$$\begin{bmatrix} 8 & 7 & 6 \\ 5 & 7 & 8 \\ 6 & 8 & 7 \end{bmatrix}$$

Draw the associated network. Formulate the network LPP and find the minimum cost of making the assignment.

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4. (a) Explain the following terms :

3+3=6

- (i) Maximization case in assignment problem
(ii) Prohibited assignment

- (b) A manufacturing company has four zones A, B, C, D and four sales engineers P, Q, R, S respectively for assignment. Since the zones are not equally rich in sales potential, it is estimated that a particular engineer operating in a particular zone will bring the following sales :

Zone A : 420000, Zone B : 336000,
Zone C : 294000, Zone D : 462000

The engineers are having different sales ability. Working under the same conditions their yearly sales are proportional to 14, 9, 11 and 8 respectively. The criteria of maximum expected total sales is to be met by assigning the best engineer to the richest zone, the next best to the second richest zone and so on. Find the optimum assignment and the maximum sales.

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UNIT—III

5. (a) Describe Markov process. Give an example of a Markov process. $3+3=6$
- (b) Suppose there are two market products of brands *A* and *B* respectively. Let each of these two brands have exactly 50% of the total market in the same period and let the market be of a fixed size. The transition matrix is given below :

$$\begin{array}{c} \text{To} \\ A \quad B \\ \text{From} \begin{array}{c} A \\ B \end{array} \begin{bmatrix} .9 & .1 \\ .5 & .5 \end{bmatrix} \end{array}$$

If the initial market share breakdown is 50% for each brand, then determine their market shares in the steady-state. 13

6. (a) Define the following terms : $3+3=6$
- (i) State-transition matrix
- (ii) Transition diagram
- (b) On January 1 (this year), Bakery *A* had 40% of its local market share while the other two bakeries *B* and *C* had 40% and 20% respectively of the market share. Based upon a study by a marketing research firm, the following were compiled :

Bakery *A* retains 90% of its customers while gaining 5% of competitor *B*'s customers and 10% of *C*'s customers. Bakery *B* retains 85% of its customers while gaining 5% of competitor *A*'s customers and 10% of *B*'s customers. Bakery *C* retains 83% of its customers while gaining 5% of competitor *A*'s customers and 10% of *B*'s customers.

What will each firm's share be on January 1, next year, and what will each firm's market share be at equilibrium?

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UNIT—IV

7. (a) Explain the following terms : $2+2+2=6$
- (i) Pure strategy
- (ii) Mixed strategy
- (iii) Value of the game

- (b) Determine which of the following two-person zero-sum games is/are strictly determinable and fair. Give optimum strategies for each player in the case of strictly determinable games : $4+4=8$

(i) Player A
$$\begin{matrix} & \text{Player B} \\ & \begin{bmatrix} 5 & 0 \\ 0 & 2 \end{bmatrix} \end{matrix}$$

(ii) Player A
$$\begin{matrix} & \text{Player B} \\ & \begin{bmatrix} 0 & 2 \\ -1 & 4 \end{bmatrix} \end{matrix}$$

- (c) Two firms are competing for business under the condition that one firm's gain is another firm's loss. Firm A's pay-off matrix is given below :

		Firm B		
		No add	Medium add	Heavy add
Firm A	No add	10	5	-2
	Medium add	13	12	15
	Heavy add	16	14	10

Suggest optimum strategies for the two firms and the net outcome using dominance property.

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8. (a) Determine the range of value of p and q that will make the pay-off element a_{22} a saddle point for the game whose pay-off matrix (a_{ij}) is given below : 6

$$\begin{matrix} & \text{Player B} \\ \text{Player A} & \begin{bmatrix} 2 & 4 & 7 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{matrix}$$

- (b) For the game with the following pay-off matrix, determine the optimal strategies and the value of the game : 6

$$\begin{matrix} & \text{Player B} \\ \text{Player A} & \begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix} \end{matrix}$$

- (c) Use graphical method to solve the following game whose pay-off matrix is given below : 7

$$\begin{matrix} & \text{Player B} \\ \text{Player A} & \begin{bmatrix} 3 & -3 & 4 \\ -1 & 1 & -3 \end{bmatrix} \end{matrix}$$
