2018

(Pre-CBCS)

(5th Semester)

MATHEMATICS

EIGHTH (A) PAPER

[MATH–354 (A)]

(Operations Research)

Full Marks : 75

Time : 3 hours

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

Put a Tick ☑ mark against the correct answer in the box provided : 1×10=10

1. Which of the following is not correct about LPP?

(a) All constraints must be of linear relationship ☐

(b) Objective function must be linear ☐

(c) All decision variables must be non-negative ☐

(d) All the constraints and decision variables must be of either or type ☐

2. If two constraints do not intersect in the positive quadrant of the graph, then

(a) the solution is feasible ☐

(b) one of the constraints is reductant ☐

(c) the solution is unbounded ☐

(d) None of the above ☐

3. For maximization LPP, the objective function coefficient for an artificial variable is

(a) 1 ☐ (b) M ☐

(c) M ☐ *(d)* zero ☐

4. The role of artificial variables in simplex method is to

(a) start the phases of simplex method ☐

(b) find shadow prices from the final simplex table ☐

(c) aid in finding initial basic feasible solution ☐

(d) None of the above ☐

5. For any primal and its dual

(a) both primal and dual cannot be feasible ☐

(b) optimum value of the objective function is same ☐

(c) primal will have an optimum solution if and only if dual does too ☐

(d) All of the above ☐

6. An assignment problem can be solved by

(a) both transportation and simplex methods ☐

(b) transportation method only ☐

(c) simplex method only ☐

(d) None of the above ☐

7. The use of cutting plane method

(a) reduces the number of constraints in the given problem ☐

(b) yields better value of the objective function ☐

(c) Both *(a)* and *(b)* ☐

(d) requires the use of standard LP approach between each cutting plane application ☐

8. Branch and bound method divides the feasible solution space into smaller parts by

(a) enumerating ☐

(b) bounding ☐

(c) branching ☐

(d) All of the above ☐

9. The size of the payoff matrix of a game can be reduced by using the principle of

(a) rotation reduction ☐

(b) game inversion ☐

(c) game transpose ☐

(d) dominance ☐

10. Games which involve more than two players are called

(a) biased games ☐

(b) *n*-person games ☐

(c) negotiable games ☐

(d) conflicting games ☐

SECTION—B

(*Marks* : 15)

Answer *all* questions : 3×5=15

1. The advertising agency wishes to reach two types of audiences, customers with annual incomes greater than ₹ 40,000 (target audience *A*) and customers with annual incomes of less than ₹ 40,000 (target audience *B*). The total advertising budget is ₹ 2,00,000. One programme of TV advertising costs ₹ 50,000; one programme of radio advertising costs ₹ 20,000. For contract reasons at least 3 programmes ought to be on TV and number of radio programmes must be limited to 5. Surveys indicate that a single TV programme reaches 750000 customers in target audience *A* and 150000 in target audience *B*. One radio programme reaches 40000 in target audience *A* and 260000 in target audience *B*.

Formulate this as an LPP and determine the media mix to maximize total reach.

2. Write down the algorithm of a maximization case using simplex method.

3. Find the optimal assignment to find the minimum cost for the following problem :

	J_1	J_2
P_1	12	24
P_2	23	18

4. Using cutting plane algorithm, solve the given IPP :

Maximize $Z \quad 5x_1 \quad 7x_2$

subject to the constraint

$$2x_1 \quad 3x_2 \quad 6$$

$$6x_1 \quad x_2 \quad 30$$

$x_1, x_2 \quad 0$ and are integers

5. Solve the game whose payoff matrix is given by

		Player B		
		B_1	B_2	B_3
	A_1	1	3	1
Player A	A_2	0	4	3
	A_3	1	5	1

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking one from each Unit

UNIT—I

1. *(a)* A firm produces three types of biscuits *A*, *B* and *C*. It packs them in assortments of two sizes *I* and *II*. The size *I* contains 20 biscuits of type *A*, 50 of type *B* and 10 of type *C*. The size *II* contains 10 biscuits of type *A*, 80 of type *B* and 60 of type *C*. A buyer intends to buy at least 120 biscuits of type *A*, 740 of type *B* and 240 of type *C*. Determine the least number of packets he should buy (using graphic method). 5

(b) Write down the algorithm for finding the solution of a given LPP using graphic method. 5

2. An agriculturist has a firm with 125 acres. He produces radish, mattar and potato. Whatever he raises is fully sold in the market. He gets ₹ 5 for radish per kg, ₹ 4 for mattar per kg and ₹ 5 for potato per kg. The average yield is 1500 kg of radish per acre, 1800 kg of mattar per acres and 1200 kg of potato per acre. To produce each 100 kg of radish, mattar and to produce each 80 kg of potato, a sum of ₹ 12·50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for radish and potato each and 5 man-days for mattar. A total of 500 man-days of labour at the rate of ₹ 40 per man-day are available. Formulate this as an LPP to maximize the agriculturist's total profit. 10

UNIT—II

3. Using simplex method, solve the given LPP : 10

Maximize $Z \quad 2x_1 \quad 3x_2 \quad x_3$

subject to the constraint

$$4x_1 \quad 3x_2 \quad x_3 \quad 6$$
$$x_1 \quad 2x_2 \quad 5x_3 \quad 4$$
$$x_1, x_2, x_3 \quad 0$$

4. Use simplex method to

minimize $Z \quad x_1 \quad 2x_2 \quad x_3$

subject to the constraint

$$x_1 \quad x_2 \quad x_3 \quad 1$$
$$6x_1 \quad 3x_2 \quad 2x_3 \quad 12$$
$$x_1, x_2, x_3 \quad 0$$

10

UNIT—III

5. *(a)* By using duality principle, solve the following LPP : 5

Maximize $Z \quad 3x_1 \quad 2x_2$

subject to the constraint

$$2x_1 \quad x_2 \quad 5$$
$$x_1 \quad x_2 \quad 3$$
$$x_1, x_2 \quad 0$$

(b) Find the initial basic feasible solution of the given transportation problem by using *(i)* least cost method and *(ii)* Vogel's approximation method : 5

	D_1	D_2	D_3
S_1	6	4	1
S_2	3	8	7
S_3	4	4	2

6. A company has four jobs to be done on four machines. Each job must be done on one and only one machine. The cost (in ₹) of each job on each machine is given in the following cost table :

Cost table (*Machine*)

Job	*W*	*X*	*Y*	*Z*
A	7	9	8	13
B	16	16	15	11
C	16	19	10	15
D	16	17	14	16

Using Hungarian method of assignment, determine the job assignment to the machines so as to minimize total cost. 10

UNIT—IV

7. Solve the following problem by branch and bound method : 10

Maximize $Z \quad 4x_1 \quad 3x_2$

subject to

$$5x_1 \quad 3x_2 \quad 30$$
$$x_1 \quad 4$$
$$x_2 \quad 6$$

$x_1, x_2 \quad 0$ and are integers

8. By using Gomory cutting plane method, solve the given IPP : 10

Maximize $Z \quad 4x_1 \quad 6x_2 \quad 2x_3$

subject to the constraints

$$4x_1 \quad 4x_2 \quad 5$$
$$x_1 \quad 6x_2 \quad 5$$
$$x_1 \quad x_2 \quad x_3 \quad 5$$

$x_1, x_2, x_3 \quad 0$ and x_3 are integers

UNIT—V

9. Use the notion of dominance to simplify the rectangular game with the following payoff :

		Player B			
		I	*II*	*III*	*IV*
Player A	*I*	4	3	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

Find its graphical solution. 10

10. Solve the following game by linear programming technique : 10

	Player B		
Player A	1	1	3
	3	5	3
	6	2	2

★ ★ ★