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(CBCS)

(5th Semester)

MATHEMATICS

EIGHTH (A) PAPER

[MATH–354 (A)]

(Operations Research)

Full Marks : 75

Time : 3 hours

(PART : A—OBJECTIVE)

(*Marks* : 25)

SECTION—A

(*Marks* : 10)

Each question carries 1 mark

Put a Tick ☑ mark against the correct answer in the box provided :

1. Operations Research (OR) is a very powerful tool for

(a) research ☐

(b) operations ☐

(c) decision-making ☐

(d) None of the above ☐

2. In an LPP, the function to be maximized (or minimized) is called

(a) the non-negativity constraints ☐

(b) the main constraints ☐

(c) the constant function ☐

(d) the objective function ☐

3. In an LPP with m constraints and n unknowns (m n), the number of basic variables will be

(a) n ☐

(b) m ☐

(c) m n ☐

(d) None of the above ☐

4. In a simplex method, if there is a tie between a decision variable and a slack (or surplus) variable, then

(a) decision variable should be selected ☐

(b) slack variable should be selected ☐

(c) surplus variable should be selected ☐

(d) All of the above ☐

5. The transportation problem deals with the transportation of

(a) a single product from several sources to a destination ☐

(b) a multi-product from several sources to several destinations ☐

(c) a single product from a source to several destinations ☐

(d) a single product from several sources to several destinations ☐

6. If there were n workers and n jobs, there would be

(a) $n!$ ☐

(b) $(n \quad 1)!$ ☐

(c) n^2 ☐

(d) n ☐

7. In a mixed integer programming problem

(a) all of the decision variables require integer solution ☐

(b) different objective functions are mixed together ☐

(c) only few of the decision variables require integer solutions ☐

(d) None of the above ☐

8. The use of cutting plane method

(a) requires the use of standard linear programming approach between each cutting plane application ☐

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

(c) yields better value of the objective function ☐

(d) Both *(b)* and *(c)* ☐

9. A game is said to be strictly determinable, if

(a) minimax value is greater than maximin value ☐

(b) minimax value is equal to maximin value ☐

(c) minimax value is less than maximin value ☐

(d) None of the above ☐

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

(a) dominance ☐

(b) rotation reduction ☐

(c) game inversion ☐

(d) None of the above ☐

SECTION—B

(*Marks* : 15)

Each question carries 3 marks

Answer the following :

1. *(a)* Express the following linear programming problem (LPP) into standard form :

Maximize $Z \quad 3x_1 \quad 2x_2 \quad 5x_3$

subject to

$$2x_1 \quad 3x_2 \quad 2x_3 \quad 40$$
$$4x_1 \quad 2x_2 \quad x_3 \quad 24$$
$$x_1 \quad 5x_2 \quad 6x_3 \quad 2$$
$$x_1 \quad 0$$

OR

(b) Solve the following LPP by graphical method :

Maximize $Z \quad 2x_1 \quad x_2$

subject to

$$3x_1 \quad 5x_2 \quad 15$$
$$3x_1 \quad 4x_2 \quad 12$$
$$x_1, \; x_2 \quad 0$$

2. *(a)* Give computational procedure for simplex method for the solution of a maximization LPP.

OR

(b) Using simplex method, solve the following simultaneous equations :

$$5x \quad y \quad 11$$
$$2x \quad 3y \quad 1$$

3. *(a)* Find the optimal assignment to find the minimum cost for the following problems :

	J_1	J_2
W_1	3	9
W_2	2	11

OR

(b) Obtain the dual problem from the following linear programming problem :

Maximize Z x_1 $3x_2$ $2x_3$

subject to

$3x_1$ x_2 $2x_3$ 7

$2x_1$ $4x_2$ 12

$4x_1$ $3x_2$ $8x_3$ 10

x_1, x_2 0 and x_3 is unrestricted.

4. *(a)* What is the importance of integer programming problem (IPP)?

OR

(b) Using cutting plane method, solve the following IPP :

Maximize Z $2x_1$ x_2

subject to

x_1 $8x_2$ 24

x_1 4

x_1, x_2 0 and integers.

5. *(a)* Solve the game whose payoff matrix is given by

	Player B		
	1	3	1
Player A	0	4	3
	1	5	1

OR

(b) For what value of , the game with the following payoff matrix is strictly determinable?

	Player B		
		6	2
Player A	–1		0
	2	4	

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The questions are of equal value

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

UNIT—I

1. A company makes two kinds of leather belts. Belt *A* is high quality belt and belt *B* is of lower quality. The respective profits are ₹ 4 and ₹ 3 per belt. Each belt of type *A* requires twice as much as that type of belt *B*. If all were of type *B*, the company could make 1200 belts per day. The supply of leather is sufficient for only 800 belts per day (both *A* and *B*). Belt *A* requires a fancy buckle and only 400 buckles are available. There are only 600 buckles a day available for belt *B*. How should the company manufacture the two types of belts in order to have a maximum profit?

2. A manufacturer of a line of patent medicines is preparing a production plant on medicines *A* and *B*. There are sufficient ingredients available to make 20000 bottles of *A* and 40000 bottles of *B* but there are only 45000 bottles into which either of the medicines can be put. Furthermore, it takes 3 hours to prepare enough material to fill 1000 bottles of *A*, it takes 1 hour to prepare enough material to fill 1000 bottles of *B* and there are 66 hours available for this operation. The profit is ₹ 8 per bottle of *A* and ₹ 7 per bottle of *B*.

(a) Formulate this problem as a linear programming problem.

(b) How should the manufacturer schedule production in order to maximize his profit?

UNIT—II

3. Solve the given LPP by using simplex method :

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

subject to

$$\begin{array}{rrrr} 3x_1 & x_2 & 2x_3 & 7 \\ 2x_1 & 4x_2 & & 12 \\ 4x_1 & 3x_2 & 8x_3 & 10 \end{array}$$

and $x_1, x_2, x_3 \quad 0$.

4. Solve the following LPP by Big-M method :

Maximize $Z \quad x_1 \quad 2x_2 \quad 3x_3 \quad x_4$

subject to

$$x_1 \quad 2x_2 \quad 3x_3 \quad 15$$
$$2x_1 \quad x_2 \quad 5x_3 \quad 20$$
$$x_1 \quad 2x_2 \quad x_3 \quad x_4 \quad 10$$

and $x_1,\ x_2,\ x_3,\ x_4 \quad 0$.

UNIT—III

5. For the following transportation problem

Source	*D*1	*D*2	*D*3	*Supply*
*S*1	9	8	5	25
*S*2	6	8	4	35
*S*3	7	6	9	40
Demand	30	25	45	100

find the initial solutions by using—

(a) North-West corner method;

(b) least cost method;

(c) Vogel's approximations method.

6. A company has four jobs *A*, *B*, *C* and *D* to be done on four machines *W*, *X*, *Y* and *Z*. 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

		W	*X*	*Y*	*Z*
Job	*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 assignments to the machine so as to minimize the total cost.

UNIT—IV

7. Use Gomory's cutting plane algorithm to solve the following LPP :

Maximize Z $3x_1$ $4x_2$

subject to

$3x_1$ $2x_2$ 8

x_1 $4x_2$ 10

x_1, x_2 0 and are integers.

8. Solve the following problem by branch and bound method :

Maximize Z $4x_1$ $3x_2$

subject to

$5x_1$ $3x_2$ 30

x_1 4

x_2 6

x_1, x_2 0 and are integers.

UNIT—V

9. Solve the following game by using the principle of dominance :

	Player B					
	4	2	0	2	1	1
	4	3	1	3	2	2
Player A	4	3	7	5	1	2
	4	3	4	1	2	2
	4	3	3	2	2	2

10. Solve the following 2 4 game by graphical method :

	Player B			
Player A	3	3	4	0
	5	4	3	7

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