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**B. Sc. (Hons.) Mathematics 5th Semester  
Old/New Scheme  
Examination – February, 2022**

**OPERATIONS RESEARCH**

Paper : BHM-356

*Time : Three Hours ]*

*[ Maximum Marks : 60*

*Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.*

*Note : Attempt five questions in all, selecting one question from each Section. Question No. 9 (Section-V) is compulsory. All questions carry equal marks.*

**SECTION – I (6 + 6 = 12 Marks)**

1. (a) Define operations research and discuss its scope briefly.

- (b) A factory engaged in the manufacturing of pistons, rings and valves for which the profits are Rs. 10, 6 and 4 respectively wants to decide the most profitable mix. It takes one hour of preparatory work, ten hours of machining and two hours of packing and allied formalities for a piston. Corresponding time requirements for rings and valves are 1, 4 and 2 and 1, 5 and 6 hours respectively. The total number of hours available for preparatory work, machining and packing and allied formalities are 100, 600 and 300 respectively. Determine the most profitable mix, assuming that what all produced can be sold. Formulate the L.P.P.

2. (a) Find the maximum value of  $z = 3x + 5y$  subject to the constraints :  $-3x + 4y \leq 12$ ,  $2x - y \geq -2$ ,  $2x + 3y \geq 12$ ,  $0 \leq x_1 \leq 4$ ,  $0 \leq x_2 \leq 2$ .

- (b) Find the minimum value of  $z = x_1 + 0.5x_2$  subject to the constraints :  $3x_1 + 2x_2 \leq 12$ ,  $5x_1 \leq 10$ ,  $x_1 + x_2 \geq 8$ ,  $-x_1 + x_2 \geq 4$   $x_1 \geq 0$  and  $x_2 \geq 0$ .

## SECTION – II

(12 Marks)

3. (a) Using Simplex method to :

Maximize  $z = 3x_1 + 2x_2 + 5x_3$  subject to the constraints :  $x_1 + 2x_2 + x_3 \leq 430$ ,  $3x_1 + 2x_3 \leq 460$ ,  $x_1 + 4x_3 \leq 420$ ;  $x_1, x_2, x_3 \geq 0$ .

(b) Use two-phase simplex method to :

Maximize  $z = x_1 + 2x_2 + 3x_3$  subject to the constraints :  $x_1 - x_2 + x_3 \geq 4$ ,  $x_1 + x_2 + 2x_3 \leq 8$ ,  $x_1 - x_3 \geq 2$ ;  $x_1, x_2, x_3 \geq 0$ .

4. (a) Solve the L.P.P.

Maximize  $z = 3x_1 + 2x_2 + 3x_3$  subject to the constraints :  $2x_1 + x_2 + x_3 \leq 2$ ,  $3x_1 + 4x_2 + 2x_3 \geq 8$ ;  $x_1, x_2, x_3 \geq 0$ . <https://www.mdustudy.com>

(b) Use Big M method to :

Maximize  $z = 2x_1 + x_2 + 3x_3$  subject to the constraints :  $x_1 + x_2 + 2x_3 \leq 5$ ,  $2x_1 + 3x_2 + 4x_3 = 12$ ,  $x_1, x_2, x_3 \geq 0$ .

## SECTION – III

(12 Marks)

5. (a) Use duality to solve the following L.P.P.

Max.  $z = x_1 - x_2 + 3x_3 + 2x_4$  subject to the constraints :  $x_1 + x_2 \geq -1$ ,  $x_1 - 3x_2 - x_3 \leq 7$ ,  $x_1 + x_3 - 3x_4 = -2$   $x_1, x_2, x_3, x_4 \geq 0$ .

(b) Solve the following transportation problems :

	To			
From	A	B	C	Available
I	50	30	220	1
II	90	45	170	3
III	250	200	50	4
Requirement	4	2	2	

6. (a) Explain North-West Corner method to solve transportation problem for an initial solution.

(b) Consider the following trans-shipment problem with two sources and two destinations, the costs for shipment in rupees are given below. Determine an optimum shipping schedule :

	<u>Source</u>		<u>Destination</u>		<u>Supply</u>
	S <sub>1</sub>	S <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	
Source	S <sub>1</sub>	0 1	6 2	4	
	S <sub>2</sub>	1 0	8 2	5	
Destination	D <sub>1</sub>	0 7	0 3	-	
	D <sub>2</sub>	1 0	1 0	-	
Demand	-	-	3 6		

**SECTION - IV (12 Marks)**

7. (a) Solve the assignment problem given below :

	A	B	C	D
I	1	4	6	3
II	9	7	10	9
III	4	5	11	7
IV	8	7	8	5

(b) MCS Inc is a software company that has three projects of Y2K with the departments of health, education and housing of Maharashtra Government. Based on the background and experiences of the project leaders, they differ in terms of their performance at various projects. The performance score matrix is given below :

Project leaders	Health	Projects Education	Housing
	P <sub>1</sub>	20	26
P <sub>2</sub>	24	32	50
P <sub>3</sub>	32	34	44

Help the management by determining the optimal assignment that maximize the total performance score.

8. (a) Solve the game whose payoff matrix is given below :

9	3	1	8	0
6	5	4	6	7
2	4	3	3	8
5	6	2	2	1

(b) Explain the graphical method of solving  $2 \times n$  and  $m \times 2$  games.

**SECTION - V (2 × 6 = 12 Marks)**

**(Compulsory Question)**

9. (a) What is symmetric game ?

- (b) Can there be multiple optimal solutions to an assignment problem ?
- (c) What is the significance of the duality theory of linear programming ?
- (d) What do you mean by degeneracy in a transportation problem ?
- (e) What is infeasible solution in L.P.P. ? Illustrate it graphically.
- (f) Define slack and surplus variables in L.P.P.
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