Reg. No.

BSCMTC 383

Choice Based Credit System VI Semester B.Sc. Examination, September 2022
(2021 – 22 Batch Onwards)
MATHEMATICS (Special Paper)
Linear Programming (Paper – VIII (b))

Time : 3 Hours

Max. Marks : 80

Instructions : *1) Answer* ***any ten*** *questions from Part –* ***A****.* ***Each*** *question carries* ***2*** *marks.*

2) Answers to Part – ***A*** *should be written in the first few pages of the answer book before answers to Part –* ***B****.*

3) Answer ***twelve*** *questions from Part –* ***B****.* ***Each*** *question carries* ***5*** *marks.*

4) Scientific calculators are ***allowed****.*

PART – A

I. Answer **any ten** questions : **(10×2=20)**

1) Define a line segment in $\mathbb{R}^n$.

2) Pivot on $a_{11} = 2$ in the following canonical maximum table.

x	y	–1	
2	3	6	$= -t_1$
1	3	2	$= -t_2$
0	2	1	= f

3) State the canonical maximization LPP represented by

x	y	–1	
1	2	3	$= -t_1$
4	5	6	$= -t_2$
7	8	9	= f

4) Convert the following LPP to canonical form.

Maximize : $f(x, y) = x + y$

Subject to $x - y \leq 3$
$2x + y \geq 1$
$0 \leq x \leq 4$
$y \geq 0.$

5) Write the tucker tableau of the canonical maximization LPP.

Maximize : $f(x, y) = x$

Subject to $x + y \leq 1$
$x - y \geq 1$
$y - 2x \geq 1$
$x, y \geq 0.$

6) Write the maximum table taking the negative transpose of the minimum table.

x_1	1	3	6
x_2	2	4	5
-1	8	7	0
	$= t_1$	$= t_2$	$= g$

7) Given the LPP below :

Maximize : $f(x_1, x_2) = x_1 + x_2$

Subject to $x_1 + 2x_2 \leq 4$
$3x_1 + x_2 \leq 6$
$x_1, x_2 \geq 0$

State the dual canonical minimization LPP.

8) Write the matrix reformulation of canonical maximization LPP.

9) Reduce the table of the matrix game.

$$\begin{bmatrix} -1 & 1 & -1 & 2 \\ -1 & -1 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$$

using domination.

10) Define mixed strategy and pure strategy for row player in the matrix game.

11) State the general balanced transportation problem.

12) Explain the process of converting an unbalanced transportation problem to a balanced transportation problem when supply is more than the demand.

13) Find two permutation set of zeros in the following table of balanced assignment problem.

0	0	1
0	0	0
1	0	0

14) Construct a cycle using circled cells in the following table.

$\enclose{circle}{C_{11}}$	$\enclose{circle}{C_{12}}$	C_{13}
C_{21}	$\enclose{circle}{C_{22}}$	$\enclose{circle}{C_{23}}$
$\enclose{circle}{C_{31}}$	C_{32}	$\enclose{circle}{C_{33}}$

PART – B

II. Answer **any twelve** questions : **(12×5=60)**

1) An appliance company manufactures heaters and airconditioners. The production of one heater requires 2 hours in the parts division of the company and 1 hour in the assembly division of the company. The production of one air-condition requires 1 hour in the parts division of the company and 2 hours in the assembly division of the company. The parts division is operated for atmost 8 hours per day and the assembly division is operated for atmost 10 hours per day. If the profit realized upon sale is \$ 30 per heater and \$ 50 per air-conditioner, how many heaters and air-conditioners should the company manufacture per day so as to maximize profits ? Solve graphically.

2) Apply the simplex algorithm to the maximum tableau.

$$\begin{array}{|cc|c|l} \multicolumn{1}{c}{x_1} & \multicolumn{1}{c}{x_2} & \multicolumn{1}{c}{-1} & \\ \hline -1 & -1 & -3 & = -t_1 \\ 1 & 2 & 2 & = -t_2 \\ \hline 2 & -4 & 0 & = f \\ \hline \end{array}$$

3) Solve using the simplex algorithm.

$$\begin{array}{|cc|c|l} \multicolumn{1}{c}{x} & \multicolumn{1}{c}{y} & \multicolumn{1}{c}{-1} & \\ \hline -1 & -1 & -2 & = -t_1 \\ 1 & -2 & 0 & = -t_2 \\ 2 & 1 & 1 & = -t_3 \\ \hline -1 & 3 & 0 & = f \\ \hline \end{array}$$

4) Solve :

Maximize : $f(x, y) = x + 3y$

Subject to $x + 2y \leq 10$

$3x + y \leq 15$

5) Solve :

Maximize : $f(x, y, z) = x + 2y + z$

Subject to $x + y + z = 6$

$x + y \leq 1$

$x, z \geq 0$

6) For any pair of feasible solutions of dual canonical LPP's, prove that $g - f = SX' + Y'T$.

7) Solve the dual canonical LPP below.

$$\begin{array}{c|cc|c|l}
 & x_1 & x_2 & -1 & \\
\hline
y_1 & -1 & 1 & -1 & = -t_1 \\
y_2 & 1 & -1 & -1 & = -t_2 \\
\hline
-1 & 1 & 1 & 0 & = f \\
\hline
 & = s_1 & = s_2 & = g &
\end{array}$$

8) Solve the dual canonical LPP below :

$$\begin{array}{c|cc|c|l}
 & x_1 & x_2 & -1 & \\
\hline
y_1 & 1 & -1 & -1 & = -t_1 \\
y_2 & -1 & -1 & -1 & = -t_2 \\
\hline
-1 & 1 & -2 & 0 & = f \\
\hline
 & = s_1 & = s_2 & = g &
\end{array}$$

9) Solve the dual non-canonical LPP below.

$$\begin{array}{c|ccc|c|l}
 & \textcircled{x_1} & \textcircled{x_2} & x_3 & -1 & \\ \hline
\textcircled{y_1} & 1 & -1 & 2 & 1 & = -o \\
y_2 & 2 & 0 & 2 & -1 & = -t_1 \\
y_3 & 0 & 1 & -1 & -1 & = -t_2 \\ \hline
-1 & 1 & -1 & 3 & 0 & = f \\ \hline
 & = o & = o & = s_1 & = g &
\end{array}$$

10) Solve the dual non-canonical LPP.

$$\begin{array}{c|cc|c|l}
 & \textcircled{x_1} & x_2 & -1 & \\ \hline
\textcircled{y_1} & 2 & -1 & -1 & = -o \\
y_2 & -1 & 1 & -1 & = -t_1 \\ \hline
-1 & 2 & 1 & 0 & = f \\ \hline
 & = o & = s_2 & = g &
\end{array}$$

11) Find the optimal strategies for the row and column players and the Von-Neumann value of the matrix game.

$$\begin{bmatrix} -\frac{5}{3} & 0 \\ 5 & \frac{-10}{3} \end{bmatrix}$$

12) Solve the matrix game.

$$\begin{bmatrix} -3 & 4 \\ 2 & -3 \end{bmatrix}$$

13) State the transportation algorithm.

14) Solve the transportation problem below.

5	12	8	50	26
11	4	10	8	20
14	50	1	9	30
15	20	26	15	

15) Solve the transportation problem below.

2	1	2	50
9	4	7	70
1	2	9	20
40	50	20	

16) State the Hungarion algorithm to solve a balanced assignment problem.

17) Solve the assignment problem.

	J_1	J_2	J_3
P_1	8	7	10
P_2	7	7	8
P_3	8	5	7

18) Explain Hungarian Algorithm of solving assignment problem.