MTE-12

ASSIGNMENT BOOKLET

Bachelor's Degree Programme
(B.Sc./B.A./B.Com.)

LINEAR PROGRAMMING

(Valid from 1st January, 2020 to 31st December, 2020)

It is compulsory to submit the Assignment before filling in the Term-End Examination Form.

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068

(2020)

Dear Student,

Please read the section on assignments in the Programme Guide for Elective Courses that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……

NAME: ……

ADDRESS: ……

……

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COURSE CODE: ……..

COURSE TITLE: ……..

ASSIGNMENT NO.: ……..…

STUDY CENTRE: ……..….. **DATE:** …….……...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) While solving problems, clearly indicate which part of which question is being solved.

6) This assignment is to be submitted to the Study Centre as per the schedule made by the study centre. **Answer sheets received after the due date shall not be accepted.**

   We strongly suggest that you retain a copy of your answer sheets.

7) This assignment is valid only upto December, 2020. If you have failed in this assignment or fail to submit it by December, 2020, then you need to get the assignment for the year 2021 and submit it as per the instructions given in the programme guide.

8) **You cannot fill the Exam Form for this course** till you have submitted this assignment. So solve it and **submit it to your study centre at the earliest.**

We wish you good luck.

Assignment
(To be done after studying all the blocks)

Course Code: MTE-12
Assignment Code: MTE-12/TMA/2020
Maximum Marks: 100

1. a) An advertising agency whishes to reach two types of audiences: customers with annual income greater than one lakh rupees (target audience A) and customers with annual income of less than one lakh rupees (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 three programmes should to be on TV and the number of radio programmes must be limited to 5. Surveys indicate that a single TV programme reaches 4,50,000 propective customers in target audience A and 50,000 in target audience B. One radio programme reaches 20,000 prospective customers in target audience A and 80,000 in target audience B. Formulate it as a LPP and solve it graphically to maximize the total reach for the programmes. (6)

   b) Obtain the dual of the following primal LP problem

   Maximize $Z = x_1 + 2x_2 + 3x_3$
   subject to the constraints
   $$-2x_1 + x_2 + 3x_3 = 2$$
   $$2x_1 - 3x_2 + 4x_3 = 1$$
   and $x_1, x_2, x_3 \geq 0$ (4)

2. a) Solve the following LP problem using the two-phase simplex method.

   Minimize $Z = x_1 - 2x_2 - 3x_3$
   Subjects to the constraints
   $$-2x_1 + 3x_2 + 3x_3 = 2$$
   $$2x_1 + 3x_2 + 4x_3 = 1$$
   and $x_1, x_2, x_3 \geq 0$. (6)

   b) Five men are available to do five different jobs. From past records, the time (in hours) that each man takes to do each job is known and given in the following table:

		Jobs				
		I	*II*	*III*	*IV*	*V*
Men	A	2	9	2	7	1
	B	6	8	7	6	1
	C	4	6	5	3	1
	D	4	2	7	3	1
	E	5	3	9	5	1

   Find the assignment of men to jobs that will minimize the total time taken. (4)

3. a) A company has factories at $F_1, F_2,$ and F_3 which supply to warehouses at W_1, W_2 and W_3. Weekly factory capacities are 200, 160 and 90 units, respectively. Weekly

warehouse requirement are 180, 120 and 150 units, respectively. Unit shipping costs (in rupees) are as follows:

		Warehouse			
		W_1	W_2	W_3	Supply
Factory	F_1	16	20	12	200
	F_2	14	8	18	160
	F_3	26	24	16	90
	Demand	180	120	150	450

Determine the optimal distribution for this company to minimize total shipping cost. (6)

b) An engineer wants to assign four new methods to three work centres. The assignment of the new methods will increase production and they are given below:

Increase in production (unit)

		Work Centres		
		A	B	C
Method	1	10	7	8
	2	8	9	7
	3	7	12	6
	4	10	10	8

If only one method can be assigned to a work centre, determine the optimum assignment. (4)

4. a) Use graphical method to solve the following game and find the value of the game. (5)

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	2	2	3	-2
	A_2	4	3	2	6

b) Player A and B, each take out one or two matches and guess how many matches the opponent has taken. If one of the players guesses correctly, then the loser has to pay him as many rupees as the sum of the number held by both players. Otherwise, the pay out is zero. Write down the payoff matrix and obtain the optimal strategies of both players. (5)

5. a) For the following payoff matrix, transform the zero-sum game into an equivalent linear programming problem and solve it by using simplex method. (6)

		Player B		
		B_1	B_2	B_3
Player A	A_1	1	-1	3
	A_2	3	5	-3
	A_3	6	2	-2

b) For the game with the following payoff matrix:

		Player B		
		B_1	B_2	B_3
Player A	A_1	-1	2	-2
	A_2	6	4	-6

Determine the best strategies for players A and B. Also determine the value of the game. Is the game (i) fair? (ii) Strictly determinable? (4)

6. a) Using the principle of dominance, solve the following game: (6)

	Player B				
Player A	B_1	B_2	B_3	B_4	B_5
A_1	2	4	3	8	4
A_2	5	6	3	7	8
A_3	6	7	9	8	7
A_4	4	2	8	4	3

b) Player A and B play a game in which each has three coins, a 5p, 10p and a 20p. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, then A wins B's coin. But, if the sum is even, then B wins A's coin. Find the best strategy for each player and the values of the game. (4)

7. a) Solve the following LP problem

Maximize $Z = 3x_1 + 5x_2$
Subject to the constraints

$$x_1 - 2x_2 \le 6$$
$$x_1 \le 10$$
$$x_2 \ge 1$$

and $x_1, x_2 \ge 0$ (6)

b) For the transportation problem

		Market				Available
		A	B	C	D	
Plant	X	14	9	18	6	11
	Y	10	11	7	16	13
	Z	25	20	11	34	19
Requirements		6	10	12	15	

If $x_{14} = 11, x_{21} = 6, x_{22} = 3, x_{24} = 4, x_{32} = 7$ and $x_{33} = 12$, test whether this solution is optimal or not. If not, find the optimal solution. (4)

8. a) Check whether the following sets are convex or not: (5)

i) $S_1 = \{(x, y) \mid y - 3 \le -x^2,\ x \ge 0, y \ge 0\}$

ii) $S_2 = \{(x, y) | y - 3 \geq -x^2, x \geq 0, y \geq 0\}$

b) Obtain all the basic solutions to the following system of linear equations: (5)

$$2x_1 + x_2 + x_3 + x_4 = 6$$
$$3x_1 + 2x_2 + x_3 + 2x_4 = 8$$

9. a) Use graphical method to solve the following LP Problem:

Maximize $Z = 3x_1 + 2x_2$

Subject to the constraints

$$x_1 - x_2 \geq 1$$
$$x_1 + x_2 \geq 3$$

and $x_1, x_2 \geq 0$ (5)

b) A diary firm has three plants located in a state. The daily milk production at each plant is as follows:

Plant 1: 6 million litres,

Plant 2: 1 million litres, and

Plant 3: 10 million litres

Each day, the firm must fulfill the needs of its four distribution centres. Minimum requirement at each centre is as follows:

Distribution Centre 1: 7 million litres,

Distribution Centre 2: 5 million litres,

Distribution Centre 3: 3 million litres, and

Distribution Centre 4: 2 million litres

Cost in hundreds of rupees of shipping one million litre from each plant to each distribution centre is given in the following table:

		Distribution Centre			
		D_1	D_2	D_3	D_4
Plant	P_1	2	3	11	7
	P_2	1	0	6	1
	P_3	5	8	15	9

Find initial basic feasible solution for given problem by using

i) North-west corner rule
ii) Least cost method

If the object is to minimize the total transportation cost. (5)

10. State which of the following statements are true and which are false. Give reasons for your answers with a short proof or a counter-example. (10)

i) The set of all convex combinations of a finite number of points $X_1, X_2, ..., X_n$ is not a convex set.

ii) If the pay-off matrix of a game is transformed, saddle point of the game if it exists, changes.

iii) If a negative value appears in the solution values (X_B) column of the simplex method, then the basic solution is optimum.

iv) In an assignment problem, if a constant is added to each element of the matrix, the optimal assignment does not change.

v) In an LPP, every feasible solution is optimal.