DHANAMANJURI UNIVERSITY
DECEMBER 2025

Name of Programme	:	**B.A./B.Sc. Mathematics**
Semester	:	**1st**
Paper Type	:	**SEC**
Paper Code	:	**SMA-001**
Paper Title	:	**Linear Programming and its Applications**
Full Marks	:	**40**
Pass Marks	:	**16**

Duration: 2 Hours

The figures in the margin indicate full marks for the questions.

1. Choose and rewrite the correct answer for the following questions: 1x4 = 4

(i) Which of the following is a necessary component of a linear programming problem?

A. Linear objective function and non linear constraints
B. Linear constraints and non linear objective function
C. Linear constraints and linear objective function
D. Non linear constraints and non linear objective function

(ii) Which of the following is not true?

A. Intersection of two convex sets is a convex set.
B. Intersection of finite number of convex sets is a convex set.
C. Union of two convex sets is a convex set.
D. A hyperplane is a convex set.

(iii) **In LPP, the optimal solution lies:**

A. At the center of the feasible region
B. Anywhere in the feasible region
C. Outside the feasible region
D. At one of the corner points of the feasible region

(iv) **If the feasible region is unbounded and the objective function is to be maximized, then:**

A. There is always a unique solution
B. There is no solution
C. The solution may or may not exist
D. The solution lies at the origin

2. Answer the following questions. **1x6=6**

A. Define a Linear programming problem.
B. State any one application of linear programming problem.
C. Define a slack variable.
D. Define an extreme point of a convex set.
E. Write two simultaneous linear inequalities which is equivalent to the equation:
$x_1 - 2x_2 + 2x_3 = 6.$
F. Define an optimal solution of an LPP.

3. Answer the following questions. **3x4=12**

a) Find all the basic solutions of

$$2x_1 + 3x_2 + 4x_3 = 5$$
$$x_1 - 2x_2 + 2x_3 = 6$$

b) Write down the LPP in standard form:

Maximize $Z = x_1 - 3x_2$ subject to the constraints:

$x_1 + 2x_2 \leq 15$

$x_1 + 3x_2 = 10$

x_1 and x_2 are unrestricted in sign.

c) A company manufactures two products P and Q. The profit contribution of P and Q are Rs 3 and Rs 4 respectively. The products P and Q require the services of four facilities. The capacities of the four facilities A, B, C, and D are limited and the available capacities in hours are 200 Hrs, 150 Hrs, and 100 Hrs and 80 hours respectively. Product P requires 5, 3, 5 and 8 hours of facilities A, B, C and D respectively. Similarly the requirement of product Q is 4, 5, 5, and 4 hours respectively on A, B, C and D. Formulate the linear programming model to Maximize the profit.

d) Prove that the set of all convex combinations of a finite number of points is a convex set.

4. Answer the following questions (choose any two): 9x2=18

a) A company manufactures two products, X and Y by using three machines A, B, and C. Machine A, B and C has 4 hours, 24 hours and 35 hours of capacity respectively, available during the coming week. One unit of product X requires 1 hour, 3 hour and 10 hours of machine A, B and C respectively. Similarly one unit of product Y requires 1 hour, 8 hour and 7 hours of machine A, B and C respectively. Profit of product X is Rs 5 per product and that of Y is Rs 7 per product. Formulate the linear programming model to maximize profit and solve graphically.

b) Use Simplex method to solve the following LPP:

$$Minimize\ Z = x_1 - 3x_2 + 2x_3 \text{ subject to the constraints}$$
$$3x_1 - x_2 + 2x_3 \leq 7$$
$$-2x_1 + 4x_2 \leq 12$$
$$-4x_1 + 3x_2 + 8x_3 \leq 10$$
$$x_1, x_2, x_3 \geq 0$$

c) Use two phase Simplex method to solve the following LPP:

$Maximize\ Z = 6x_1 + 4x_2$ subject to the constraints

$2x_1 + 3x_2 \leq 30$

$3x_1 + 2x_2 \leq 24$

$x_1 + x_2 \geq 3$

$x_1, x_2 \geq 0$

d) Use Big M method to solve the following LPP:

$Maximize\ Z = -x_1 - x_2$ subject to the constraints

$2x_1 + x_2 \geq 4$

$x_1 + 7x_2 \geq 7$

$x_1, x_2 \geq 0$

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