UNIT-I

1. Define Alternative optima.
   When the objective function is parallel to a binding constraint, the objective function will assume the same optimum value at more than one solution point.

2. Define Unbounded solution.
   When the values of the decision variables may be increased indefinitely without violating any of the constraints, the solution space is unbounded. The value of the objective function may increase or decrease indefinitely. Thus, both the solution space and the objective function value are unbounded.

3. Define Infeasible solution.
   When the constraints are not satisfied simultaneously, the LPP has no feasible solution. This situation can never occur if all the constraints are of the $\leq$ type.

4. Write the general LPP.

   Maximize or Minimize $Z = \sum_{j=1}^{n} c_j x_j$ ------ (1)

   Subject to the constraints

   $\sum_{j=1}^{n} a_{ij} x_j \leq (or) = (or) \geq b_i, i = 1, 2, ..., m$ ------ (2)

   $x_j \geq 0, j = 1, 2, ..., n$ ------ (3)

   (1) is called the objective function.
   (2) are called constraints of the LPP.
   (3) are called the non-negative restrictions.

5. Define a solution to the general LPP.
   An n-tuple $(x_1, x_2, ..., x_n)$ of real numbers that satisfies the constraints of the LPP is called a solution to the LPP.

6. Define a feasible solution to the LPP.
   Any solution to the LPP which also satisfies the non-negative restrictions of the problem is called a feasible solution to the LPP.

7. Define an Optimum or Optimal Solution.
   Any feasible solution which optimizes (minimizes or maximizes) the objective function of the LPP is called an optimum solution of the LPP.

8. Define slack variables.

   Let the constraints of the general LPP be $\sum_{j=1}^{n} a_{ij}x_j \le b_i$

   Then the non-negative variables x_{n+i} which satisfy

   $$\sum_{j=1}^{n} a_{ij}x_j + x_{n+i} = b_i, i = 1, 2, ..., k$$

   are called slack variables.

9. Define surplus variables.

   Let the constraints of the general LPP be $\sum_{j=1}^{n} a_{ij}x_j \ge b_i$

   Then the non-negative variables x_{n+i} which satisfy

   $$\sum_{j=1}^{n} a_{ij}x_j - x_{n+i} = b_i, i = k+1, k+2, ..., l$$

   are called surplus variables.

10. Define the Canonical form of LPP.

    Maximize $Z = \sum_{j=1}^{n} c_j x_j$

    Subject to the constraints

    $$\sum_{j=1}^{n} a_{ij}x_j \le b_i, i = 1, 2, ..., m$$

    $$x_j \ge 0, j = 1, 2, ..., n$$

11. Characteristics of the canonical form.

(i) The objective function is of maximization type.

(ii) All constraints are of the $\leq$ type.

(iii) All the variables are non-negative.

12. How will you convert the minimization type of objective function into maximization type?

Minimize Z = - Maximize (Z*)

Where Z*= - Z

13. How will you convert the inequality of the $\geq$ type into the inequatity of the $\leq$ type?

An inequality of the $\geq$ type can be changed to an inequality of the $\leq$ type by multiplying both sides of the inequality by -1.

14. How will you write the variable which is unrestricted in sign?

If x_j is unrestricted in sign, then it can be written as

$x_j = x_j' - x_j''$ where $x_j', x_j'' \geq 0$.

15. Write the Standard form of LPP.

Maximize or Minimize $Z = \sum_{j=1}^{n} c_j x_j$

Subject to the constraints

$$\sum_{j=1}^{n} a_{ij} x_j = b_i, i = 1, 2, ..., m$$

$$x_j \geq 0, j = 1, 2, ..., n$$

16. Write the characteristics of the Standard form of LPP.

(i) All the constraints are expressed in the form of equations.

(ii) The R.H.S of each constraint equation is non-negative.

17. Define a basic solution of a system of equations.

Given m equations and n unknowns. The solution obtained by setting n-m variables equal to zero and solving the resulting system is called the basic solution of the given system of equations.

18. Define a degenerate solution.
A basic solution to the system is called degenerate if one or more of the basic variables vanish.

19. Define basic feasible solution.
A feasible solution to an LPP which is also a basic solution to the problem is called a basic feasible solution to the LPP.

UNIT-2

1. Name two artificial variable techniques.
   Big-M method
   Two Phase Method

2. What is the purpose of introducing artificial variables?
   Artificial variables are used to obtain an initial basic feasible solution.

3. What type of constraints having artificial variables?
   The constraints are of the $\leq$ type and = type have artificial variables.

4. In Big-M method, what does M refer to?
   M refers to the larger value.

5. Under what conditions, the given LPP does not possess any feasible solution?
   If Max $Z^* < 0$, and at least one artificial variable is present in the basis with positive value, then the given LPP does not possess any feasible solution.

6. What is the indication of the degenerate solution in Big-M method?
   If at least one variable is present in the basis with zero value, the current optimum basic feasible solution is degenerate.

UNIT-3

1. Define Transportation problem.
   Transportation Problem is a special case of LPP in which the objective is to transport various quantities of a single homogeneous commodity from various sources to different destinations in such a way that the total transportation cost is minimum.

2. Write the Mathematical Formulation of a TP.

   Minimize $Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$

   Subject to the constraints

   $$\sum_{j=1}^{n} x_{ij} = a_i, i = 1, 2, ..., m$$

   $$\sum_{i=1}^{m} x_{ij} = b_j, j = 1, 2, ..., n$$

   $x_{ij} \geq 0,$ for all i and j

3. What is the necessary and sufficient condition for the existence of a feasible solution to the TP.
   Total Supply = Total Demand

4. Explain Least cost method.
   Step 1. Select the upper left hand corner cell and allocate $x_{11} = \min(a_1, b_1)$

Five mark questions

1. Explain Graphical solution method.

Step 1. Identify the problem, the decision variables, the objective function and the restrictions.

Step 2. Set up the mathematical formulation of the problem.

Step 3. Plot a graph representing all the constraints of the problem and identify the feasible region. The feasible region is the intersection of all the regions represented by the constraints of the problem and is restricted to the first quadrant only.

Step 4. The feasible region may be bounded or unbounded. Compute the coordinates of all the corner points of the feasible region.

Step 5. Find out the value of the objective function at each corner point.

Step 6. Select the corner point that optimizes the value of the objective function. It gives the optimum feasible solution.

2. Explain Simplex algorithm.
   Refer book

Unit 2

1. Explain Big-M algorithm (Refer book)
2. Explain Two-Phase method (Refer book)

Unit 3

1. Explain North-West corner method(Refer book)
2. Explain Vogel's Approximation Method(Refer book)
3. Explain Transportation Algorithm (MODI method) (Refer book)