K1- LEVEL QUESTIONS

UNIT I:

1. In linear programming, constraints can be represented by

A. equalities
B. inequalities
C. ratios
D. **both a and b**

2. One subset which satisfies inequality part of equation is graphically represented by

A. domain area of y intercept
B. range area of x intercept
C. straight line
D. **shaded area around straight line**

3. If there is no significant differences in item quality supplied by different sources then it is classified as

A. **Homogenous**
B. heterogeneous
C. indifferent items
D. different items

4. One of two subsets for solution set, one subset satisfies equality part of equation and other subset solves

A. range part of equation
B. domain part of equation
C. equality part of equation
D. **in-equality part of equation**

5. For linear inequalities, solution set for a group of inequalities is classified as

A. concave set
B. **convex set**
C. loss set
D. profit set

6. In linear programming, lack of points for a solution set is said to

A. have no feasible solution
B. **have a feasible solution**
C. have single point method
D. have infinte point method

7. Operations research is the application of _____methods to arrive at the optimal solutions to the problems.

A. economical
B. scientific
C. a and b both
D. artistic

8. Feasible solution satisfies _____

A. Only constraints
B. [a] and [b] both
C. only non-negative restriction
D. [a],[b] and Optimum solution

9. In Degenerate solution value of objective function _____.

A. increases infinitely
B. basic variables are nonzero
C. decreases infinitely
D. One or more basic variables are zero

10. Minimize Z = _____

A. –maximize(Z)
B. -maximize(-Z)
C. maximize(-Z)
D. none of the above

UNIT 2:

11. In graphical method the restriction on number of variables is _____.

A. 2
B. not more than 3
C. 3
D. none of the above

12. In graphical representation the bounded region is known as _____ region.
A. Solution
B. basic solution
C. feasible solution
D. optimal

13. Graphical optimal value for Z can be obtained from

A. Corner points of feasible region
B. Both a and c
C. corner points of the solution region
D. none of the above

14. In LPP the condition to be satisfied is

A. Constraints have to be linear
B. both [a]and [b]
C. Objective function have to be linear
D. none of the above

15. The solution to LPP give below is, Max Z = x+y subject to the constraints 2x+3y<=12, 3x – 2y <= 2 and x,y >=0

A. Unbounded solution
B. Max Z = 3
C. Max Z = 14
D. Infeasible solution

16. The solution to LPP give below is Max Z = x+y subject to the constraints 2x – 3y<=12, 3x+ 2y <= 2 and x,y >=0

A. Unbounded solution
B. Max Z = 15
C. Max Z = 30
D. Infeasible solution

17. In the definition of LPP m stands for number of constraints and n for number of variables, then which of the following relations hold

A. m = n
B. m ≥ n
C. m ≤ n
D. None

18. The linear function of variables which is to be maximized or minimized is called _____

A. constraints
B. **objective function**
C. basic requirements
D. none of them

19. Operation research approach is

A. **Multi-disciplinary**
B. Intuitive
C. Artificial
D. All of the above

20. Operation research analysts do not
A. **Predict future operation**
B. Collect the relevant data
C. Build more than one model
D. Recommend decision and accept

UNIT 3 :

21. Mathematical model of Linear Programming is important because
A. **It helps in converting the verbal description and numerical data into mathematical expression**
B. decision makers prefer to work with formal models
C. it captures the relevant relationship among decision factors
D. it enables the use of algebraic techniques

22. A constraint in an LP model restricts
A. value of the objective function
C. use of the available resources
B. **value of the decision variable**
D. all of the above

23. In graphical method of linear programming problem if the ios-cost line coincide with a side of region of basic feasible solutions we get
A. Unique optimum solution
B. no feasible solution
C. unbounded optimum solution
D. **Infinite number of optimum solutions**

24. A feasible solution of LPP
A. **Must satisfy all the constraints simultaneously**
B. Need not satisfy all the constraints, only some of them
C. Must be a corner point of the feasible region
D. all of the above

25. The objective function for a L.P model is 3x1+2x2, if x1=20 and x2=30, what is the value of the objective function?
A. 0
B. 60
C. 50
D. **120**

26. Maximization of objective function in LPP means
A. Value occurs at allowable set decision
B. **highest value is chosen among allowable decision**
C. none of the above
D. all of the above

27. Alternative solution exist in a linear programming problem when
A. one of the constraint is redundant
B. **objective function is parallel to one of the constraints**
C. two constraints are parallel

D. all of the above

28. Linear programming problem involving only two variables can be solved by _____

A. Big M method
B. **Graphical method**
C. Simplex method
D. none of these

29. The linear function of the variables which is to be maximize or minimize is called _____

A. Constraints
B. Decision variable
C. **Objective function**
D. None of the above

30. A physical model is an example of

A. **An iconic model**
B. A verbal model
C. An analogue model
D. A mathematical model

UNIT 4:

31. If the value of the objective function z can be increased or decreased indefinitely, such solution is called _____

A. Bounded solution
B. Solution
C. **Unbounded solution**
D. None of the above

32. A model is

A. An essence of reality
B. An idealization
C. An approximation
D. **All of the above**

33. The first step in formulating a linear programming problem is

A. Identify any upper or lower bound on the decision variables
B. State the constraints as linear combinations of the decision variables
C. Understand the problem
D. **Identify the decision variables**

34. In the simplex method for solving of LPP number of variables can be _____.

A. Not more than three
B. at least two
C. **at least three**
D. none of them

35. In the simplex method the variable enters the basis if _____.

A. $Zj - Cj \geq 0$
B. **$Zj - Cj < 0$**
C. $Zj - Cj \leq 0$

D. Zj – Cj = 0

36. In the simplex method the variable leaves the basis if the ratio is

A. maximum

B. 0

C. **minimum**

D. none of them

37. The _____ variable is added to the constraint of less than equal to type.

A. **slack**

B. artificial

C. surplus

D. basic

38. For the constraint of greater than equal to type we make use of _____ variable.

A. slack

B. artificial

C. **surplus**

D. basic

39. The coefficient of slack variable in the objective function is _____.

A. -M

B. **0**

C. +M

D. none of them

40. The coefficient of artificial variable in the objective function of maximization problem is _____.

A. **-M**

B. 0

C. +M

D. none of them.

UNIT 5:

41. The role of artificial variables in the simplex method is

A. to aid in finding an initial solution

B. to find optimal dual prices in the final simplex table

C. to start with Big M method

D. **all of these**

42. For a minimization problem, the objective function coefficient for an artificial variable is

A. **+ M**

B. Zero

C. -M

D. None of these

43. For maximization LPP, the simplex method is terminated when all values

A. **cj –zj ≤ 0**

B. cj –zj = 0

C. cj –zj ≥ 0

D. zj ≤ 0

44. If any value in b - column of final simplex table is negative, then the solution is
A. unbounded
B. optimal
C. **infeasible**
D. None of these

45. To convert ≥ inequality constraints into equality constraints, we must
`
A. add a surplus variable
B. subtract an artificial variable
C. **subtract a surplus variable and an add artificial variable**
D. add a surplus variable and subtract an artificial variable

46. n the optimal simplex table cj –zj = 0 value indicates
A. unbounded solution
B. **alternative solution**
C. cycling
D. None of these

47. At every iteration of simplex method, for minimization problem, a variable in the current basis is replaced with another variable that has
A. a positive cj –zj value
B. cj –zj = 0
C. **a negative cj –zj value**
D. None of these

48. A variable which does not appear in the basis variable (B) column of simplex table is
A. never equal to zero
B. called basic variable
C. **always equal to zero**
D. None of these

49. To formulate a problem for solution by the simplex method, we must add artificial variable to
A. only equality constraints
B. **both A & B**
C. only > constraints
D. None of these

50. If all xij values in the incoming variable column of the simplex table are negative, then
A. **solution is unbounded**
B. there exist no solution
C. there are multiple solution
D. None of these

OPERATIONS RESEARCH I

K2- LEVEL QUESTIONS

UNIT I:

1. What is Degenerate solution?
   One or more basic variables are zero in the value of objective function. This solution is called degenerate solution.
2. How to convert Minimize Z in simplex method?
   maximize(-Z)
3. In graphical method, what is the restriction in number of variables?
   If the basic variables are two, then only we can apply the graphical method.

4. How to identify the solution space in graphical representation?
   In graphical method, the common region for all constraint is known as solution space.
5. How to obtain a optimal value in graphical method?
   Graphical optimal value for Z can be obtained from corner points of the solution region
6. Define Objective function.
   The linear function of variables which is to be maximized or minimized is called objective function
7. When will we use slack variable?
   If we have less than or equal to inequality constraints, then we add slack variable and convert it into equation.
8. Surplus variable- define.
   If we have greater than or equal to inequality constraints, then we subtract surplusvariable and convert it into equation.
9. Write one difference between standard form and canonical form.
   - **In standard form, The objective function must be in maximization type.**
   - **In canonical form, The objective function may be in maximization or minimization type.**
10. Convert this objective function of the LPP into standard form: Min Z = 2x + 3y.
    Max (– Z) = –2x – 3y

Unit II:

1. What is the meaning of Maximization of objective function in LPP?

   highest value is chosen among allowable decision
2. When will the alternative solution exist in a linear programming problem?
   objective function is parallel to one of the constraints
3. Linear programming problem involving more than two variables can be solved by:
   Simplex method
4. Define unbounded solution.
   If the value of the objective function Z can be increased or decreased indefinitely, such

solution is called Unbounded solution

5. What is the first step in formulating a linear programming problem?

Identify the decision variables

6. In the simplex method the variable enters the basis if :

Zj – Cj < 0

7. In the simplex method the variable leaves the basis if the ratio is

minimum

8. How to denote the coefficient of artificial variable in the objective function of maximization problem?

-M

9. What is another name for the Big-M method?

Penalty method

10. How to denote the coefficient of artificial variable in the objective function of minimization problem?

+M

UNIT-III

11. List the scope of applications of OR techniques.

Answer : Scope of Operations Research is Cash management Inventory control Simulation techniques Capital budgeting

12. What is sensitivity analysis?

Answer : The change in parameters of the problem may be discrete or continuous. The study of the effect of discrete changes in parameters on the optimal solution is called the sensitivity analysis.

13. List the methods used to arrive at an initial basic feasible solution in a transportation model.

Answer : North-West corner method

Least cost method

Column Minima method

Row Minima method

Vogel's Approximation method

14. How does a travelling salesman problem differ from a routine assignment model?

Answer : Travelling salesman problem is similar to the assignment problem with the difference that there is the additional constraint that no city is to be visited again before the tour of all the cities is completed.

15. Define zero sum game

Answer : It is a game in which the sum of payments to all the players after the play of the game is zero.

16. Define Simulation.

Answer : The imitation of reality which may be in the physical form or in the form of mathematical equations may be called simulation.

17. What is meant by EOL?

Answer : EOL means economic order level. There should be enough for each time so that customers orders can be reasonably met from this stock until replenishment. This Stock level, becomes economic order level.

18. Define Constraints.

Answer : Linear Programming Problem deals with the optimization of a function of variables known as objective function , subject to set of linear equalities/ inequalities known as constraints. The constraints may beimposed by diff Subject to

$x1 + x2 \leq 5$

$3x1 + 5x2 \leq 15$

$x1, x2 \geq 0$

Dual of primal problem:

$* = 5y1 + 15y2$

Subject to

$y1 + 3y2 \geq 2$

$y1 + 5y2 \geq 3$

$y1, y2 \geq 0$

Dual of Dual problem:

$x \quad = 2x1 + 3x2$

Subject to

$x1 + x2 \leq 5$

$3x1 + 5x2 \leq 15$

$x1, x2 \geq 0$

∴ Dual of dual problem is primal problem.

20. What are the transient nodes in a transportation problem?

Answer : Transportation problems are special minimum cost network flow models for which every node is either a pure supply node or pure demand node. i.e., all flow goes immediately from source node to a sink node where it is demanded.

UNIT-IV

21. What is Gomory's fraction cut?

Answer : A systematic procedure for solving pure integer programming problem was first developed by R.E .Gomory in 1958. Later on the extended the procedure to solve mixed Integer programming problem named as cutting plane algorithm. The method consists in first solving the Integer programming problem as ordinary Linear programming problem by ignoring the integrity restriction and then introducing additional constraints one after the other to cut certain part of the solution space until an integer solution is obtained.

22. Define a stage in dynamic programming.

Answer : A stage signifies a portion of the total problem for which a decision can be taken. At each stage there are a number of alternative and the best of those is called the stage decision, which may not be optimal for the stage but contributes to obtain the optimal decision policy.

23. Define pay-off as applied to decision theory.

Answer : If the outcome is measured in terms of money then it is called a pay-off. A pay-off matrix is calculated by the cross tabulation of the alternative A and the possible events.

24. List any two applications of Simulation.

Answer : Simulation is used for solving inventory problems, queueing problems, training problems etc.

25. Define Operations Research.

Answer : Operations Research a scientific approach to problem solving for executive decision making which requires the formulation of mathematical, economic and satisfied models for decision and control problems to deal with situations arising out of risk and uncertainty.

26. Define degenerate solution in Linear Programming Problem.

Answer : In Linear Programming Problem, intersection of two constraints will define a corner point of the feasible region. But if more than two constraints pass through any one of the corner points of the feasible region, excess constraints will not serve any purpose and therefore they act as redundant constraints.

27. Write a Linear Programming model of the assignment model.

Answer : $= 11x11 + 12\,x12 + \cdots + 1 \quad x1 \quad + 21x21 + 22x22 + \cdots + 2$
$x2$

$+ \cdots + \quad 1x \quad 1 + \cdots + \quad x$

Subject to

$x11 + x12 + \cdots + x1 \quad = 1\ x21 + x22 + \cdots + x2 \quad = 1 \vdots x \quad 1 + x \quad 2 + \cdots + x \quad = 1\ x11 + x21 + \cdots + x \quad 1 = 1\ x12 + x22 + \cdots + x \quad 2 = 1 \vdots x1 \quad + x2 \quad + \cdots + x \quad = 1\ x \quad \geq 0; \quad = 1,2, \ldots \quad ; \quad = 1,2, \ldots$

28. Distinguish between transportation problem and transshipment problem.

Answer : Transportation problem Transshipment problem

Shipments are dent directly from a particular source to particular destination The objective is to minimize the total cost of shipments and thus the shipment passes through one or more intermediate nodes before it reaches its desired destination Transportation problem is used to solve the problem Transshipment problem cannot be solved as such by the usual transportation algorithm but slight modification is required before applying it to the transshipment problem

29. Write the conditions for a fathomed sub problem of branch and bound techniques in integer

programming problem.

Answer : A problem is said to be fathomed if any one of the following three conditions true The value of the decision variables of the problem are integer The upper bound of the problem which as non integer values for its decision variable is not greater than the current best lower bound The problem has infeasible solution.

30. State Bellman's principle of optimality.

Answer : It states that "An optimality policy has the property that whatever be the initial decisions the remaining decision must constitute an optimal policy for the state resulting from the first decision".

UNIT V

1. Times between two successive requests arriving, called the
   Poisson distribution
2. One of most widely used exponential distributions is called a

   Poisson distribution

3. Number of jobs in the system called ------.
   Queue

4. -------- = Time between arrival and beginning of service
Waiting time
5. Write the explanation of FIFO.
First In First Out
6. How many server in M/M/1 model?
Single
7. How many server in M/M/N model?
N - number of server
8. How to denote the arrival rate of customer?

9. How to denote the departure rate of customer?

10. How to characterize the idle time in M/M/1:N/FIFO model?
1 – P_0.

K3 LEVEL QUESTIONS

UNIT I:

1. Write the procedure to formulate the LPP.

2. A firm manufactures headache pills in two sizes A and B. Size A contains 2 grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine. Size B contains 1 grain of aspirin, 8 grains of bicarbonate and 6 grains of codeine. It is found by users that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate effect. It is required to determine the least number of pills a patient should take to get immediate relief. Formulate the problem as a standard LPP.

3.A firm manufactures two types product A and B on which the profit per is Rs 3 and Rs 4 respectively. Each product is processed on two machines M1 and M2 . Product A requires one minute on M1 and two minutes on M2 while B requires one minute on M1 and one minute M2. Machine M1 is available for not more than 7 hours while M2 is available for 10 hours on any working day. Formulate as an LPP and find the number of units of product A and B to be manufactured to get maximum profit?

4. A factory involved in manufacturing of pistons, rings and valves for which the profits per units 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 for a piston. Corresponding time requirements for the rings and valves are 1,4 and 2 and 1,5 and 6hours respectively. The total number of hours available for preparatory work, machining and packing are 100, 600 and 300 respectively. Formulate the LPP.

5. A company makes two kinds of leather belts. Belt A is a high quality belt and belt B is a lower quality. The respective profits are Rs 4.00 and Rs 3.00 per belt. Each belt of type A requires twice as much time as a belt of type B. And if all belts were of type B, the company could make 1000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 buckles per day are available. There are only 700 buckles a day available for belt B. Determine the optimal product mix.(USE GRAPH)

6. Reduce the following linear programming problem to its standard form:

Max (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 unrestricted in sign.

7. Define linear programming problem and their components.

8. Rewrite in standard form the following linear programming problem:

Min (z) = $2x_1 + x_2 + 4x_3$

Subject to the constraints:

$-2x_1 + 4x_2 \leq 4$,

$x_1 + 2x_2 + x_3 \geq 5$,

$2x_2 + 3x_3 \leq 2$,

$x_1, x_2 \geq 0$ and x_3 unrestricted in sign.

9. Using graphical method: Maximize $z = 4x_1 + 10x_2$ subject to the constraints:

$2x_1 + x_2 \leq 50$,

$2x_1 + 5x_2 \leq 100$,

$2x_1 + 3x_2 \leq 90$: $x_1 \geq 0$, and $x_2 \geq 0$

10. Explain about slack and surplus variables with example.

UNIT II:

1. Use BIG M method to

Maximize $z = 6x_1 + 4x_2$ subject to the constraints:

$2x_1 + 3x_2 \leq 30$,

$3x_1 + 2x_2 \leq 24$,

$x_1 + x_2 \geq 3$, $x_1 \geq 0$ and $x_2 \geq 0$.

2. Use simplex method to solve the following L.P.P

Maximize $z = 4x_1 + 10x_2$

subject to the constraints:

$2x_1 + x_2 \leq 50$,

$2x_1 + 5x_2 \leq 100$,

$2x_1 + 3x_2 \leq 90$: $x_1 \geq 0$, and $x_2 \geq 0$.

3. Use BIG M method to

Maximize $z = 6x_1 + 4x_2$ subject to the constraints:

$2x_1 + 3x_2 \leq 30$,

$3x_1 + 2x_2 \leq 24$,

$x_1 + x_2 \geq 3$, $x_1 \geq 0$ and $x_2 \geq 0$.

4. Use simplex method to solve the following L.P.P:

Maximize $z = 4x_1 + 10x_2$ subject to the constraints:

$2x_1 + x_2 \leq 50$,

$2x_1 + 5x_2 \leq 100$,

$2x_1 + 3x_2 \leq 90$: $x_1 \geq 0$, and $x_2 \geq 0$.

5. Define Basic Solution, Basic feasible solution, Basic Variables

6. Explain Degenerate Solution and Optimum basic feasible solution.

7. Why we use artificial variables? Give example.

8. Use simplex method to solve the following L.P.P:

Min $z = 5x_1 + x_2$ subject to the constraints:

$2x_1 + x_2 \leq 2$

$3x_1 + 4x_2 \geq 12$,

$x_1 \geq 0$, and $x_2 \geq 0$. Show that it has an infeasible solution.

9. Show that the following problem has an unbounded solution.

Max $z = 5x_1 + 3x_2$ subject to the constraints:

$2x_1 - 4x_2 \leq 16$,

$3x_1 + 4x_2 \geq 12$,

$x_1 \geq 0$, and $x_2 \geq 0$.

10. Use BIG M method to

Min $z = 3x_1 + 2x_2$ subject to the constraints:

$3x_1 + x_2 = 3$,

$4x_1 + 3x_2 \geq 6$,

$x_1 + 2x_2 \leq 4$, $x_1 \geq 0$ and $x_2 \geq 0$.

UNIT-3:

1. What is transportation problem?

2. Explain transportation problem and show that it can be considered as an LPP

3. What is a balanced transportation problem? What are its applications?

4. Describe an unbalanced transportation table?

5. Explain north- west corner method to solve transportation problem for an initial Solution
6.What is meant by an optimality test in a transportation problem

7. What is stepping stone in transportation table?

8. Give a brief outline of a procedure for solving a transportation problem

9. Write a short note on Time- minimization in transportation problem

10. What are the common methods to obtain an initial basic feasible solution for a transportation problem whose cost & requirements table is given? Give a stepwise Procedure for one of them

UNIT-4

1. What is an assignment problem? Explain

2. Give the mathematical formulation of a assignment problem

3.”An assignment problem is a special case of a transportation problem”, Explain

4. What us an assignment problem? Give 2 applications in health care administration

5. Explain the difference between a transportation problem & assignment problem?

6. If in a assignment problem, we add a constant to every element of a row of the cost matrix, the prove that an assignment plan which minimizes the total cost for the new matrix, also minimizes the total cost for the original cost matrix

7. Can there be multiple optimal solutions to a assignment problem? How would you identify the existence of multiple solutions, if any?

8. Write a short note on travelling salesman problem?

9. Describe a method of drawing minimum number of lines in the context of assignment problem Name the method

10. How will you solve an assignment problem where a particular assignment is prohibited? Give an example to show that an assignment problem can be formulated as a linear programming problem

UNIT 5:

A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for both deposits and withdrawals is exponential with mean service time 3 minutes per customer. Depositors are found to arrive in Poisson fashion throughout the day with mean arrival rate of 16 per hour. Withdrawers also arrive in Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits? What could be the effect if this could be accomplished by increasing the mean service time to 3.5 minutes?

A tax consulting firm has four service stations in its office to receive people who have problems and complaints about their income, wealth and sales taxes. Arrivals follow a Poisson distribution and average 80 persons in an 8-hour service day. Each tax advisor spends an irregular amount of time serving the arrivals which have been found to have an exponential distribution. The average service time is 20 minutes. Calculate the average number of customers in the system, average number of customers waiting to be serviced, average time a customer spends in the system and average waiting time for a customer. Calculate how many hours each week a tax advisor spends performing his job. What is the probability that a customer has to wait before he gets service? What is the expected number of idle tax advisors at any specified time?

A TV repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they came in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8-hour day, what is repairman's expected idle time each day? How many jobs are ahead of the average set just brought in?

At a railway station, only one train is handled at a time. The railway yard is sufficient only for two trains to wait while other is given signal to leave the station. Trains arrive at the station at an average rate of 6 per hour and the railway station can handle them on an average of 12 per hour. Assuming Poisson arrivals and exponential service distribution, find the steady-state probabilities for the various number of trains in the system. Also find the average waiting time of a new train coming into the yard.

A super market has two girls serving at the counters. The counters arrive in a Poisson fashion at the rate of 12 per hour. The service time for each customer is exponential with mean **6** minutes,

find (i) the probability that an arriving customer has to wait for service, (ii) the average number of customers in the system, and (iii) the average time spent by a customer in the super-market .

Explain about the classification of queueing models.

Explain about queue discipline.

List the input process of the queueing system and explain.

What the different types of service mechanism , explain.

Write the condition of deterministic queueing system.

K4 LEVEL QUESTIONS

UNIT I:

1. A company has three operational departments (weaving, processing and packing) nwith capacity to produce three different types of clothes namely suitings, shirtings and woolens yielding a profit of Rs. 2, Rs. 4 and Rs. 3 per meter respectively. One meter of suiting requires 3 min in weaving, 2 min in processing and 1 min in packing. Similarly one meter of shirting requires 4 min in weaving, 1 min in processing and 3 mins in packing. One meter of woolen requires 3 minutes in each department. In a week, total run time of each department is 60, 40, and 80 hours for weaving, processing and packing respectively. Formulate LPP.

2. An animal feed company must produce 200 lbs of a mixture containing the ingredients X_1 and X_2. X_1 cost Rs. 3/lb and X_2 cost Rs. 8/lb. Not more than 80 lbs. of X_1 can be used and minimum quantity to be used for X_2 is 60 lbs. Find how much of each ingredient should be used if the company wants to minimize the cost. Formulate the LPP.

3. What are the major steps involved to find a solution using graphical method.

4. Use the graphical method to solve the following LPP

Min $Z = -x + 2y$

Subject to the constraints:

$-x + 3y \leq 10$, $x + y \leq 6$, $x - y \leq 2$ and $x, y \geq 0$.

5. Use the graphical method to solve the following LPP

Max $Z = 2x + 3y$

Subject to the constraints:

$x + y \leq 30$, $x - y \geq 0$, $y \geq 3$, $0 \leq x \leq 20$ and $0 \leq y \leq 12$.

UNIT II:

1. Write the algorithm to find the optimal solution using simplex Method.

2. Describe the steps involved in the penalty method.

3. Use simplex method to solve the following LPP

Max $Z = 2x + 3y$

Subject to the constraints:

$x + y \leq 30$, $x - y \geq 0$, $y \geq 3$, $0 \leq x \leq 20$ and $0 \leq y \leq 12$

4. Use simplex method to solve the following LPP

Min $Z = -x + 2y$

Subject to the constraints:

$-x + 3y \leq 10$, $x + y \leq 6$, $x - y \leq 2$ and $x, y \geq 0$.

5. Use Big M method to solve the following LPP:

Max $Z = 6x + 4y$

Subject to the constraints:

$2x + 3y \leq 30$, $3x + 2y \leq 24$, $x + y \geq 3$ and $x, y \geq 0$.

UNIT III:

1. Explain how the profit maximization transportation problem can be converted to an Equivalent cost minimization transportation problem

2. What is a transshipment problem? Explain how a transshipment problem can be formulated & Solved as a transportation problem

3. Explain briefly a) north- west corner rule b) minimum matrix method c) Vogel's approximation method for finding an initial basic feasible solution for a transportation problem

4. Prove that every standard cost minimizing transportation problem has a feasible solution

5. How the problem of degeneracy arises in transportation problem? Explain how does one overcome it?

UNIT IV:

1. What is an assignment problem, and how do you interpret it as a linear programming model?

2. Give in detail the computational procedure of solving an assignment problem?

3. Discuss the 'Hungarian' method of solving an assignment problem

4. Explain the method of solving a maximization assignment method

5. Explain the nature of a travelling salesman problem & give its mathematical formulation?

UNIT V:

1. Explain the basic elements of a queuing system in detail.

2. Describe about the operating characteristics of a queueing system.

3. Consider a single server queueing system with poisson input, exponential service times. Suppose the mean arrival rate is 3 calling units per hour, the expected service time is 0.25 hours and the maximum permissible number calling units in the system is two. Derive the steady state probability distribution of the number of calling units in the system and then calculate the expected number in the system.

4. Assume that the goods trains are coming in a yard at the rate of 30 trains per day and suppose that the inter arrival times follow an exponential distribution. The service time for each train is assumed to be exponential with an average of 30 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purposes), calculate the probability that the yard is empty and find the average queue length.

5. Patients arrive at a clinic according to a Poisson distribution at a rate of 30 patients per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate 20 per hour.

i) Find the effective arrival rate at the clinic

ii) What is the probability that an arriving patient will not wait?

iii) What is the expected waiting time until a patient is discharged from the clinic?