

DEPARTMENT OF B.COM – BANKING AND INSURANCE

17UBI 4A5 -OPERATIONS RESEARCH

K1 LEVEL

UNIT - I

1. Operations research is the application of _____ methods arrive at the optimal solutions to the problems.

- economical
- Artistic
- **Scientific**
- None of the above

2. A feasible solution to an LP problem.

- **Must satisfy all of the problem's constraints simultaneously**
- Need not satisfy all of the constraints, only some of them
- Must be a corner point of the feasible region
- Must optimize the value of the objective function

3. In Degenerate solution value of objective function

- increases infinitely
- basic variables are nonzero
- decreases infinitely
- **One or more basic variables are zero**

4. _____ may be defined as a method of determining an optimum programme inter dependent activities in view of available resources.

- Goal Programming
- **Linear Programming**
- Decision-making
- None of the above

5. In graphical method the restriction on number of constraints is _____.

- 2
- not more than 3
- 3

- **none of the above**
6. In graphical representation the bounded region is known as _____ region.
- Solution
 - basic solution
 - **feasible solution**
 - optimal
7. Graphical optimal value for Z can be obtained from
- **Corner points of feasible region**
 - optimal
 - corner points of the solution region
 - none of the above
8. LP model is based on the assumptions of _____ .
- Proportionality
 - Additively
 - Certainty
 - **All of the above**
9. Operation research approach is
- **Multi-disciplinary**
 - Intuitive
 - Artificial
 - All of the above
10. Operation research analysts do not
- **Predict future operation**
 - Collect the relevant data
 - Build more than one model
 - Recommend decision and accept
11. Mathematical model of Linear Programming is important because
- **It helps in converting the verbal description and numerical data into mathematical expression**
 - decision makers prefer to work with formal models
 - it captures the relevant relationship among decision factors
 - it enables the use of algebraic techniques
12. In graphical method of linear programming problem if the isocost line coincide with a side of region of basic feasible solutions we get
- **Unique optimum solution**
 - no feasible solution

- unbounded optimum solution
 - **Infinite number of optimum solutions**
13. A feasible solution of LPP
- **Must satisfy all the constraints simultaneously**
 - Need not satisfy all the constraints, only some of them
 - Must be a corner point of the feasible region
 - all of the above
14. Maximization of objective function in LPP means
- Value occurs at allowable set decision
 - **highest value is chosen among allowable decision**
 - none of the above
 - all of the above
15. Alternative solution exist in a linear programming problem when
- one of the constraint is redundant
 - **objective function is parallel to one of the constraints**
 - two constraints are parallel
 - all of the above
16. Linear programming problem involving only two variables can be solved by _____
- Big M method
 - **Graphical method**
 - Simplex method
 - none of these
17. The first step in formulating a linear programming problem is
- Identify any upper or lower bound on the decision variables
 - State the constraints as linear combinations of the decision variables
 - Understand the problem
 - **Identify the decision variables**
18. Graphic method can be applied to solve a LPP when there are only _____ variable
- One
 - More than One
 - **Two**
 - Three
19. If the feasible region of a LPP is empty, the solution is _____ .
- **Infeasible**
 - Unbounded

- Alternative
- None of the above

20. In LPP, degeneracy occurs in _____ stages
- One
 - **Two**
 - Three
 - Four

UNIT - II

21. VAM stands for _____
- Vogel's Approximation Method
 - Vogel's Approximate Method
 - Vangel's Approximation Method
 - **Vogel's Approximation Method**
22. Once the initial basic feasible solution has been computed, what is then the next step in solving the problem .
- VAM
 - Modified distribution method
 - **Optimality test**
 - None of the above
23. One can find the initial basic feasible solution by using _____.
- **VAM**
 - Modified distribution method
 - Optimality test
 - None of the above
24. A given TP is said to be unbalanced, if the total supply is not equal to the total _____ .
- Optimization
 - **Demand**
 - Cost
 - None of the above
25. For maximization in TP, the objective is to maximize the total _____
- Solution
 - Profit Matrix
 - **Profit**
 - None of the above

26. The initial solution of a transportation problem can be obtained by applying any known method. However, the only condition is that
- **Rim condition should be satisfied**
 - one of the $X_{ij} < 0$
 - cost matrix should be square
 - None of them
27. In non-degenerate solution number of allocated cells is _____.
- Equal to $m+n-1$
 - Equal to $m+n+1$
 - **Not equal to $m+n-1$**
 - Not equal to $m+n+1$
28. From the following methods _____ is a method to obtain initial solution to Transportation Problem.
- **North-West**
 - Hungarian
 - Simplex
 - Newton Raphson
29. The Penalty in VAM represents difference between _____ cost of respective row /column.
- Two Largest
 - largest and smallest
 - **smallest two**
 - none of them
30. Number of basic allocations in any row or column in Assignment Problem can be
- **Exactly one**
 - at least one
 - at most one
 - none of them
31. North – West corner refers to _____.
- **Top left corner**
 - both of them
 - top right corner
 - none of them
32. The _____ method's solution for transportation problem is

sometimes an optimal solution itself.

- NWCM
 - LCM
 - **VAM**
 - Row Minima
33. One can find the initial basic feasible solution by using _____.
- **VAM**
 - MODI
 - Optimality test
 - None of the above
34. The solution to a transportation problem with m-rows and n-columns is feasible if number of positive allocations are
- m+n
 - **m + n-1**
 - mxn
 - all of the above
35. The initial solution of a transportation problem can be obtained by applying any known method. However, the only condition is that
- the solution be optimal
 - **the rim condition are satisfied**
 - the solution not be degenerate
 - all of the above
36. The dummy source or destination in a transportation problem is added to
- **satisfy rim condition**
 - prevent solution from becoming degenerate
 - ensure that total cost does not exceed a limit
 - all of the above
37. The occurrence of degeneracy while solving a transportation problem means that
- total supply equals total demand
 - **the solution so obtained is not feasible**
 - the few allocations become negative
 - none of the above
38. An alternative optimal solution to a minimization transportation problem exists whenever opportunity cost corresponding to unused routes of transportations .

- positive and greater than zero
 - **positive with at least one equal to zero**
 - negative with at least one equal to zero
 - all of the above
39. One disadvantage of using North-West Corner Rule to find initial solution to the transportation problem is that
- it is complicated to use
 - **it does not take into account cost of transportation**
 - it leads to degenerate initial solution
 - all of the above
40. The solution to a transportation problem with m-rows and n-columns is feasible if number of positive allocations are
- m+n
 - **m + n-1**
 - mxn
 - all of the above

UNIT - III

41. In Assignment Problem the value of decision variable x_{ij} is _____.
- no restriction
 - **one or zero**
 - two or one
 - none of them
42. If number of sources is not equal to number of destination in Assignment problem then it is called _____.
- **unbalanced**
 - unsymmetrical
 - symmetric
 - balanced
43. The _____ method used to obtain optimum solution of travelling salesman problem.
- Simplex
 - dominance
 - **Hungarian**
 - graphical
44. An assignment problem is considered as a particular case of a

Transportation problem because

- the number of rows equals columns
- all $x_{ij} = 0$
- all rim conditions are 1
- **all of above**

45. The method used for solving an assignment problem is called
- Reduced matrix method
 - **Hungarian method**
 - MODI method
 - none of the above
46. An optimal of an assignment problem can be obtained only if
- each row and column has only one zero element
 - each row and column has at least one zero element
 - the data are arrangement in a square matrix
 - **none of the above**
47. The Hungarian method for solving an assignment problem can also be used to solve
- A transportation problem
 - Assignment
 - **a traveling salesman problem**
 - none of the above
48. In sequencing if smallest time for a job belongs to machine-1 then that job has to placed _____ of the sequence.
- In the middle
 - **in the starting**
 - attend
 - none of them
49. In sequencing the time involved in moving jobs from one machine to another is _____
- **negligible**
 - positive number
 - significant
 - none of them
50. _____ operation is carried out on a machine at a time.
- Two
 - At least one
 - **Only one**
 - none of them

51. Processing time M_{ij} 's are _____ of order of processing the jobs.
- dependent
 - negligible
 - **independent**
 - none of them
52. What aims at optimizing inventory levels?
- Inventory Control
 - Inventory Capacity
 - **Inventory Planning**
 - None of the above
53. Activity which starts only after finishing other activity is called
- dummy
 - **successor**
 - predecessor
 - none of them
54. Burst and Merge are types of _____ in networking.
- **event**
 - arrow
 - activity
 - tools
55. Activity which does not require any resources or time is called _____.
- **dummy**
 - successor
 - Predecessor
 - none of them
56. Activity which is completed before starting new activity is called _____.
- dummy
 - successor
 - **predecessor**
 - none of them
57. Merge event represents _____ of two or more events.
- beginning
 - splitting
 - **completion**
 - none of them
58. _____ event represents beginning of more than one activities.
- **burst**

- dummy
- merge
- none of them

59. _____ is indicated by dotted arrow.

- burst event
- **dummy activity**
- merge event
- none of them

60. The Objective of network analysis to

- **Minimize total project duration**
- Minimize total project cost
- Minimize production delays, interruption and conflicts
- All of the above

UNIT - IV

61. Network models have advantage in terms of project

- Planning
- Controlling
- Scheduling
- **All of the above**

62. The slack for an activity is equal to

- LF-LS
- **LS-ES**
- EF-ES
- None of the above

63. The Another term commonly used for activity slack time is

- Total float
- independent float
- Free float
- **All of the above**

64. If an activity has zero slack, it implies that

- **It lies on the critical path**
- It is a dummy activity
- The project progressing well
- None of the above

65. Key concept under which technique are network of events and activities , resource

allocation, time and cost considerations, network paths and critical paths?

- Game Theory
- **Network Analysis**
- Decision Theory
- None of the above

66. Assignment problem helps to find a maximum weight identical in nature in a weighted_____ .

- Tripartite graph
- **Bipartite graph**
- Partite graph
- None of the above

67. All the parameters in the linear programming model are assumed to be _____

- Variables
- **Constraints**
- Functions
- None of the above

68. Every LPP is associated with another LPP is called _____

- Primal
- **Dual**
- Non-linear programming
- None of the above

69. As for maximization in assignment problem, the objective is to maximize the _____

- **Profit**
- optimization
- cost
- None of the above

70. _____ is one of the fundamental combinatorial optimization problems.

- **Assignment problem**
- Transportation problem
- Optimization Problem
- None of the above

71. What is being considered as one of the most versatile management tools?

- Electronic Computers
- **Linear Programming**
- Computer Programming

- None of the above

72. The word 'Linear' means that the relationships are represented by _____ .

- Diagonal lines
- Curved lines
- **Straight lines**
- Slanting lines

73. The word 'programming' means taking decisions _____ .

- **Systematically**
- Rapidly
- Slowly
- Instantly

74. Who originally called it 'Programming of interdependent activities in a linear structure' but later shortened it to 'Linear Programming'?

- **Danzig**
- Kantorovich
- Marshall
- None of the above

75. LP can be applied in farm management problems which relate to the allocation of resources such as

_____, in such a way that it maximizes net revenue

- Acreage
- Labour
- Water supply or working capital
- **All of the above**

76. What can be defined as a useful idle resource which has economic value eg; raw materials, spare parts, finished items, etc?

- Inventory Control
- **Inventory**
- Inventory Planning
- None of the above

77. Which of the following is not an inventory?

- **Machines**
- Raw material
- Finished products
- Consumable tools

78. The following classes of costs are usually involved in inventory decisions except

- Cost of ordering

- Carrying cost
 - Cost of shortages
 - **Machining cost**
79. The cost of insurance and taxes are included in
- Cost of ordering
 - Set up cost
 - **Inventory carrying cost**
 - Cost of shortages
80. 'Buffer stock' is the level of stock
- Half of the actual stock
 - At which the ordering process should start
 - **Minimum stock level below which actual stock should not fall**
 - Maximum stock in inventory

UNIT - V

81. The minimum stock level is calculated as
- **Reorder level – (Normal consumption x Normal delivery time)**
 - Reorder level + (Normal consumption x Normal delivery time)
 - (Reorder level + Normal consumption) x Normal delivery time
 - (Reorder level + Normal consumption) / Normal delivery time
82. The time period between placing an order its receipt in stock is known as
- **Lead time**
 - Carrying time
 - Shortage time
 - Over time
83. Re-ordering level is calculated as
- **Maximum consumption rate x Maximum re-order period**
 - Minimum consumption rate x Minimum re-order period
 - Maximum consumption rate x Minimum re-order period
 - Minimum consumption rate x Maximum re-order period
84. Average stock level can be calculated as
- **Minimum stock level + ½ of Re-order level**
 - Maximum stock level + ½ of Re-order level
 - Minimum stock level + 1/3 of Re-order level
 - Maximum stock level + 1/3 of Re-order level
85. The Economic Order Quantity (EOQ) is calculated as
- **$(2D*S/h)^{1/2}$**
 - $(DS*/h)^{1/2}$
 - $(D*S/2h)^{1/2}$
 - $(D*S/3h)^{1/2}$
86. Activities related to coordinating, controlling and planning flow of inventory are

classified as

- decisional management
- throughput management
- **inventory management**
- manufacturing management

87. Which of the following statements regarding PERT times is true?

- **Optimistic time estimate is an estimate of the minimum time an activity will require.**
- Optimistic time estimate is an estimate of the maximum time an activity will require.
- The probable time estimate is calculated as $t = (a + 4m + b)/6$.
- Pessimistic time estimate is an estimate of the minimum time an activity will require.

88. Which of the following statements regarding critical paths is true?

- The shortest of all paths through the network is the critical path.
- Some activities on the critical path may have slack.
- Every network has exactly one critical path.
- **On a specific project, there can be multiple critical paths, all with exactly the same duration.**

89. Which of the following statements concerning CPM activities is false?

The late finish of an activity is the earliest late start of all preceding activities.

The early finish of an activity is the early start of that activity plus its duration.

The late finish is the earliest of the late start times of all successor activities.

The late start of an activity is its late finish less its duration.

90. Which of the following statements regarding CPM networks is true?

- The early finish of an activity is the latest early start of all preceding activities.
- The late finish of an activity is the earliest late start of all preceding activities.
- **On a specific project, there can be multiple critical paths, all of which will have exactly the same duration.**
- A project does not have to have a critical path.

91. Which of the following statements regarding project management is true?

- Both PERT and CPM require that network tasks have unchanging durations.
- **Shortening the project by assigning more resources to one or more**

of the critical tasks is called "project crashing."

- Crashing need not consider the impact of crashing an activity on other paths in the network.
- Project crashing is an optimizing technique.

92. Which of these statements regarding time-cost tradeoffs in CPM networks is true?
- Crashing is not possible unless there are multiple critical paths.
 - Crashing a project often reduces the length of long-duration, but non-critical, activities.
 - Activities not on the critical path can never be on the critical path, even after crashing.
 - **Crashing shortens the project duration by assigning more resources to one or more of the critical tasks.**
93. In a CPM/PERT network a dummy activity is necessary when
- two activities have the same starting node
 - two activities have the same ending node
 - a node does not actually connect to another node
 - **when two activities share the same starting and ending node**
94. Shared slack in an activity network is defined as
- the amount of time an activity can be delayed without delaying the entire project.
 - **the amount of slack that an activity has in common with another activity.**
 - the amount of unused resources for an activity.
 - the amount by which a time estimate can be in error without affecting the critical path computations.
95. If an activity has zero activity slack it
- means that the project is expected to be delayed.
 - must be a dummy activity
 - **is on the critical path.**
 - all of the above
96. PERT analysis is based on
- optimistic time

- pessimistic time
- most likely time
- **all the above.**

97. Critical path method

- is an improvement upon bar chart method
- provides a realistic approach to daily problems
- avoids delays which are very common in bar charts
- **All the above.**

98. While scheduling a project by C.P.M.

- a project is divided into various activities
- required time for each activity is established
- sequence of various activities is made according to their importance
- **All the above.**

99. The performance of a specific task in CPM, is known

- Dummy
- Event
- **Activity**
- Contract.

100. Completion of an activity on CPM network diagram, is generally known

- Event
- Connector
- Node
- **All the above.**

K2 LEVEL

Unit - I

1. What is linear programming problem in operation research?

Operation research is an approach to decision-making, which involves a set of methods to operate a system. In the above example, my system was the Delivery model. Linear programming is used for obtaining the most optimal solution for a problem with given constraints.

2. What is LPP and formulation of LPP?

Linear Programming Problem and Its Mathematical Formulation. Linear Programming Problems (LPP) provide the method of finding such an optimized function along with/or the values which would optimize the required function accordingly. It is one of the most important Operations Research tools.

3. What do you mean by linear programming problem?

Linear Programming. Linear programming is often used in business to find maximum profit or minimum cost. The first step in solving linear programming problems is to set up a function that represents cost, profit, or some other quantity to be maximized or minimized subject to the constraints of the problem.

4. What do you mean by linear programming problem?

Linear Programming. Linear programming is often used in business to find maximum profit or minimum cost. The first step in solving linear programming problems is to set up a function that represents cost, profit, or some other quantity to be maximized or minimized subject to the constraints of the problem.

5. What are the benefits of linear programming?

Some of the advantages of Linear Programming are: Utilized to analyse numerous economic, social, military and industrial problem. Linear programming is most suitable for solving complex problems. Helps in simplicity and productive management of an organization which gives better outcomes.

6. What are linear programming techniques?

Linear programming, mathematical modelling technique in which a linear function is maximized or minimized when subjected to various constraints. This technique has been useful for guiding quantitative decisions in business planning, in industrial engineering, and—to a lesser extent—in the social and physical sciences.

7. What type of math is linear programming?

Linear programming (LP, also called linear optimization) is a method to achieve the best outcome (such as maximum profit or lowest cost) in a mathematical model whose requirements are represented by linear relationships.

8. What is LPP?

LPP stands for Linear Programming Problems. According to Wikipedia. It is a method to achieve the best outcome (such as maximum profit or lowest cost) in a mathematical model whose requirements are represented by linear relationships. Linear programming is a special case of mathematical programming.

9. What are the applications of linear programming?

Linear programming provides a method to optimize operations within certain constraints. It is used to make processes more efficient and cost-effective. Some areas of application for linear programming include food and agriculture, engineering, transportation, manufacturing and energy

10. Why do we use linear programming?

Linear programming is used for obtaining the most optimal solution for a problem with given constraints. In linear programming, we formulate our real life problem into a mathematical model. It involves an objective function, linear inequalities with subject to constraints.

11. What is graphical method of linear programming?

Graphical method of linear programming is used to solve problems by finding the highest or lowest point of intersection between the objective function line and the feasible region on a graph. This process can be broken down into 7 simple steps explained below.

12. What is feasible region in graphical method?

In mathematical optimization, a feasible region, feasible set, search space, or solution space is the set of all possible points (sets of values of the choice variables) of an optimization problem that satisfy the problem's constraints, potentially including inequalities, equalities, and integer constraints.

13. What are the characteristics of linear programming?

Linear programming problems are distinctive in that they are clearly defined in terms of an objective function, constraints and linearity. The characteristics of linear programming make it an extremely useful field that has found use in applied fields ranging from logistics to industrial planning.

14. What is the graphical method?

Graphical Methods. Graphs are powerful data evaluation tools. They provide quick, visual summaries of essential data characteristics. A few simple plots can replace complex statistical equations or tests to interpret environmental data. ...Graphical methods are typically used with quantitative statistical evaluations.

15. What is meant by feasible and optimal solution in graphical method of solving a LPP?

The graphical method is applicable to solve the LPP involving two decision variables x_1 , and x_2 , we usually take these decision variables as x , y instead of x_1 , x_2 . To solve an LP, the graphical method includes two major steps. a) The determination of the solution space that defines the feasible solution.

16. What is a graphical method of data presentation?

Frequency distributions and are usually illustrated graphically by plotting various types of graphs:

Bar graph - A bar graph is a way of summarizing a set of categorical data. It displays the data using a number of rectangles, of the same width, each of which represents a particular category.

17. What is graphical optimization?

Graphical optimization is a simple method for solving optimization problems involving one or two variables. For problems involving only one optimization variable, the minimum (or maximum) can be read simply from a graph of the objective function.

18. What is the graphical method for simultaneous equations?

Graphical. Solution of simultaneous linear equations in order to solve simultaneous linear equations graphically draw the graph that is a straight line for each given equation. Then find the coordinates of the point of intersection of the two lines drawn.

19. How do you solve graphically?

To solve an equation means to find all the values that make the statement true. To solve an equation graphically, draw the graph for each side, member, of the equation and see where the curves cross, are equal. The x values of these points are the solutions to the equation.

20. What is graphical representation of data?

A chart is a graphical representation of data, in which "the data is represented by symbols, such as bars in a bar chart, lines in a line chart, or slices in a pie chart". A data chart is a type of diagram or graph that organizes and represents a set of numerical or qualitative data.

Unit-II

21. What is transportation in operation research?

The most important and successful applications in the optimization refers to transportation problem (TP), that is a special class of the linear programming (LP) in the operation research (OR). Approach: The main objective of transportation problem solution methods is to minimize the cost or the time of transportation.

22. What is balanced transportation problem in operational research?

Balanced Transportation Problem in Operational Research Quantitative Techniques for management. When the total supplies of all the sources are equal to the total demand of all destinations, the problem is a balanced transportation problem.

23. What is transportation problem definition?

The transportation problem is a special type of linear programming problem where the objective is to minimise the cost of distributing a product from a number of sources or origins to a number of destinations. Because of its special structure the usual simplex method is not suitable for solving transportation problems.

24. What are the types of transportation problem?

Transportation Problem (TP) is based on supply and demand of commodities transported from several sources to the different destinations. There are two types of Transportation Problem namely

- (1) Balanced Transportation Problem and
- (2) Unbalanced Transportation Problem.

25. What is the objective of transportation problem?

The most important and successful applications in the optimization refers to transportation problem (TP), that is a special class of the linear programming (LP) in the operation research (OR). Approach: The main objective of transportation problem solution methods is to minimize the cost or the time of transportation.

26. What is a balanced transportation problem?

Balanced Transportation Problem is a transportation problem where the total availability at the origins is equal to the total requirements at the destinations.

27. How do you solve an unbalanced transportation problem?

The given problem is an unbalanced transportation problem. To convert the unbalanced transportation problem into a balanced problem, add a dummy destination (dummy column). i.e., the demand of the dummy destination is equal to, Thus; a dummy destination is added to the table, with a demand of 100 units.

28. What is degeneracy in transportation problem?

Degeneracy Transportation Problem. If the basic feasible solution of a transportation problem with m origins and n destinations has fewer than $m + n - 1$ positive x_{ij} (occupied cells), the problem is said to be a degenerate transportation problem. Degeneracy can occur at two stages: At the initial solution.

29. What is Vogel's approximation method?

The Vogel Approximation Method is an improved version of the Minimum Cell Cost Method and the Northwest Corner Method that in general produces better initial basic feasible solution, which are understood as basic feasible solutions that report a smaller value in the objective (minimization) function of a balanced.

30. What is the transportation method?

The Transportation Method of linear programming is applied to the problems related to the study of the efficient transportation routes i.e. how efficiently the product from different sources of production is transported to the different destinations, such as the total transportation cost is minimum.

31. What do you mean by unbalanced transportation problem?

A transportation problem is said to be unbalanced if the supply and demand are not equal. Two situations are possible:- 1. If Supply < demand, a dummy supply variable is introduced in the equation to make it equal to demand

32. What is meant by feasible solution?

A feasible solution is a set of values for the decision variables that satisfies all of the constraints in an optimization problem. The set of all feasible solutions defines the feasible region of the problem.

33. What are the objectives of transport?

Expanding and improving the transport infrastructure in a timely manner; improving the quality and coordination of public transport services; and. managing road use to reduce congestion and promote safety.

34. What is transportation and assignment problem?

When assignment is a problem it becomes a typical optimization problem it can therefore be compared to a transportation problem. The transportation problem is a special class of the linear programming problem. it deals with the situation in which a commodity is transported from sources to destinations.

35. How assignment problem is a special case of transportation problem?

Assignment Problem. A special case of the transportation problem is the assignment problem which occurs when each supply is 1 and each demand is 1. In this case, the integrality implies that every supplier will be assigned one destination and every destination will have one supplier.

36. What is basic feasible solution in transportation problem?

A feasible solution (not necessarily basic) is said to be optimal if it minimizes the total transportation cost. To solve a transportation problem first we need to find an initial basic feasible solution and then get an optimum solution.

37. What is dummy destination?

A dummy origin or destination is an imaginary origin or destination with zero cost introduced to make an unbalanced transportation problem balanced.

38. What is the stepping stone method?

The Stepping Stone Method is used to check the optimality of the initial feasible solution determined by using any of the method Viz. North-West Corner, Least Cost Method or Vogel's Approximation Method.

39. What is meant by optimality test in transportation problem?

U-V Method Optimality Test. U-V Method Optimality Test is used to check the optimality of a basic feasible solution consisting of $(m+n-1)$ independent positive allocations and a set of arbitrary number u_i and v_j ($i=1,2,\dots,m$; $j=1,2,\dots,n$) such that $c_{ij} = u_i + v_j$ for all occupied cells (i,j) .

40. What is the importance of transport?

What Is the Importance of Transportation? Transportation is important because it facilitates trade, exchange and travel. Without effective transportation, regions are largely isolated from each other. Effective, affordable transportation also plays a role in letting people move to new areas.

Unit - III

41. What is assignment problem in operation research?

Assignment problem is a special type of linear programming problem which deals with the allocation of the various resources to the various activities on one to one basis. It does it in such a way that the cost or time involved in the process is minimum and profit or sale is maximum.

42. What are the objectives of assignment problem?

The objective of assignment problem is to assign a number of jobs to an equal number of machines so as to minimize the total assignment cost or to minimize the total consumed time

for execution of all the jobs. In the multi-objective assignment problem, the objectives alone are considered as fuzzy.

43. What is assignment technique?

The assignment method is used to determine what resources are assigned to which department, machine, or centre of operation in the production process. This method is used to allocate the proper number of employees to a machine or task, and the number of jobs that a given machine or factory can produce.

44. What is assignment problem in DAA?

The assignment problem is one of the fundamental combinatorial optimization problems in the branch of optimization or operations research in mathematics. It consists of finding a maximum weight matching (or minimum weight perfect matching) in a weighted bipartite graph.

45. What are the applications of assignment problem?

It involves assignment of people to projects, jobs to machines, workers to jobs and teachers to classes etc., while minimizing the total assignment costs.} One of the important characteristics of assignment problem is that only one job (or worker) is assigned to one machine (or project)

46. What is assignment problem and its application?

Assignment problem is a special type of linear programming problem which deals with the allocation of the various resources to the various activities on one to one basis. It does it in such a way that the cost or time involved in the process is minimum and profit or sale is maximum.

47. What is maximization assignment problem?

There are problems where certain facilities have to be assigned to a number of jobs so as to maximize the overall performance of the assignment. The problem can be converted into a minimization problem in the following ways and then Hungarian method can be used for its solution.

48. What is balanced assignment problem?

The Assignment problem can be Balanced or Unbalanced problem. A Balanced problem means the no. of rows and no. of columns in the problem are equal. E. g. if the problem contains 4 workers and 4 jobs, then it is balanced.

49. What is assignment model?

The model is a special case of the transportation method. In order to generate an assignment problem it is necessary to provide the number of jobs and machines and indicate whether the problem is a minimization or maximization problem. The number of jobs and machines do not have to be equal but usually they are.

50. What is the importance of assignment?

This homework is of immense displeasure for students as they think studying in the school or college timings is enough for them. The main purpose of assignments is to increase the learning capabilities of students. The more we use our brains, the more they develop.

51. What is sequencing problem.

Definition. An arithmetic sequence is a sequence of numbers in which each term is given by adding a fixed value to the previous term. For example, -2, 1, 4, 7, 10, ... is an arithmetic sequence because each term is three more than the previous term. In this case, 3 is called the common difference of the sequence.

52. What are examples of sequence?

Each number in the sequence is called a term. In the sequence 1, 3, 5, 7, 9, ..., 1 is the first term, 3 is the second term, 5 is the third term, and so on. The notation $a_1, a_2, a_3, \dots, a_n$ is used to denote the different terms in a sequence. The expression a_n is referred to as the general or n th term of the sequence.

53. What are the types of sequences?

An arithmetic sequence is a sequence with the difference between two consecutive terms constant. The difference is called the common difference. A geometric sequence is a sequence with the ratio between two consecutive terms constant. This ratio is called the common ratio.

54. What is series and sequence?

A sequence is an ordered list of numbers and the sum of the terms of a sequence is a series. In an arithmetic sequence, each term is equal to the previous term, plus (or minus) a constant. The constant is called the common difference (d).

55. What is sequence in real analysis?

Sequences occur frequently in analysis, and they appear in many contexts. ... Definition A sequence of real numbers is any function $a : \mathbb{N} \rightarrow \mathbb{R}$. Often sequences such as these are called real sequences, sequences of real numbers or sequences in \mathbb{R} to make it clear that the elements of the sequence are real numbers.

56. Why is sequencing important?

Sequencing refers to the identification of the components of a story, such as the beginning, middle, and end, and also to the ability to retell the events within a given text in the order in which they occurred. The ability to sequence events in a text is a key comprehension strategy, especially for narrative texts.

57. Why can all sequences be described as functions?

A sequence is a function whose domain is the set of natural numbers or a subset of the natural numbers. We usually use the symbol a_n to represent a sequence, where n is a natural number and a_n is the value of the function on n . Each number in a sequence is a term of the sequence.

58. What are sequences in SQL?

Sequence is a set of integers 1, 2, 3, that are generated and supported by some database systems to produce unique values on demand. A sequence is a user defined schema bound object that generates a sequence of numeric values.

59. What is sequencing and scheduling?

Sequencing refers to the order in which activities occur in the operations process. The operations manager constantly analyses the sequencing to improve the efficiency of the business. Scheduling refers to the length of time different activities take in the operations process.

60. What is sequencing in manufacturing?

Just in sequence (JIS) is an inventory strategy that matches just in time (JIT) and complete fit in sequence with variation of assembly line production. Components and parts arrive at a production line right in time as scheduled before they get assembled. JIS is sometimes called in-line vehicle sequencing (ILVS).

Unit - IV

61. What are the 4 types of inventory?

Generally, inventory types can be grouped into four classifications: raw material, work-in-process, finished goods, and MRO goods.

62. What do you mean by inventory model?

Inventory model is a mathematical model that helps business in determining the optimum level of inventories that should be maintained in a production process, managing frequency of ordering, deciding on quantity of goods or raw materials to be stored, tracking flow of supply of raw materials and goods to provide .

63. What is inventory control operations management?

Inventory generally refers to the materials in stock. It is, therefore, necessary to hold inventories of various kinds to act as a buffer between supply and demand for efficient operation of the system.

64. What is inventory control model?

Inventory control is concerned with minimizing the total cost of inventory. In the U.K. the term often used is stock control. The three main factors in inventory control decision making process are: The cost of holding the stock (e.g., based on the interest rate).

65. What are the 5 types of inventory?

Generally speaking, inventory types can be placed into six different categories: raw materials; work-in-progress; finished goods; maintenance, repair, and operating (MRO) goods; services; and transportation.

66. What are the 3 types of inventory?

A typical manufacturer will identify three types of inventory: raw materials, work in process and finished goods. Raw materials are the basic "inputs" of production -- steel, wood, plastic, chemicals and anything else that gets turned into the final product.

67. What is difference between inventory and stock?

Differences between Inventory and Stock. While stock deals with products that are sold as part of the business's daily operation, inventory includes sale products and the goods and materials used to produce them. The more stock that is sold, the higher the revenues.

68. What are the types of inventory control?

That being said, there are two different types of inventory control systems available today: perpetual inventory systems and periodic inventory systems. Main Inventory Control System Types: Perpetual Inventory System. Periodic Inventory System

69. What are the components of inventory?

The key components of cost generally include: Parts, raw materials and supplies used, Labour, including associated costs such as payroll taxes and benefits, and. Overhead of the business allocable to production.

70. What are the advantages of inventory control?

(i) Efficient inventory control methods can reduce but cannot eliminate business risk. (ii) The objectives of better sales through improved service to customer; reduction in inventories to reduce size of investment and reducing cost of production by smoother production operations are conflicting with each other.

71. What are the functions of inventory control process?

The primary function of inventory is to use marketing and production to increase profitability, to get the maximum amount for the business' investment. The other functions of inventory, such as balancing supply and demand, improving efficiency, establishing a safety stock and geographical specialization.

72. How do you control inventory?

Basic inventory control techniques and procedures

- Determine the right amount of stock using the Economic Order Quantity formula or Reorder Point Formula.
- Keep your stock organized with easily understandable SKUs.

- Keep an eye on quality control using batch tracking software.

73. Why is inventory control important?

Inventory control is also important to maintaining the right balance of stock in your warehouses. Too much inventory can trigger profit losses—whether a product expires, gets damaged, or goes out of season. Key to proper inventory control is a deeper understanding of customer demand for your products.

74. What is an inventory control technique?

Based on the Pareto Principle (also known as the 80-20 rule stating that 80% of the overall consumption value is based on only 20% of the total items), ABC analysis is a popular technique for dividing on-hand inventory into three categories: A, B, and C, based on annual consumption unit, inventory value, and cost .

75. What is inventory planning?

Inventory planning refers to the process that any organization adopts to determine the optimal quantity as well as timing, with the sole aim of aligning such plans with the organization's capacity to produce and make sales. Inventory planning, usually affects the company in a number of ways.

76. What are the two types of inventory?

There are two main types of inventory accounting. There are two main types of inventory accounting systems: the periodic system and the perpetual system. The periodic inventory system is used for inexpensive goods. A perpetual inventory system uses computer software to keep a running record of inventory on hand.

77. How do you value inventory?

Inventory value. Determination of the cost of unsold inventory at the end of an accounting period. Inventory is valued usually at cost or at the market value, whichever is lower. The four common valuation methods are first-in, first-out (FIFO), last-in, first-out (LIFO), average cost (AVCO), and specific identification.

78. What are the purposes of inventory?

The purpose of inventory control is to efficiently manage the availability of stock for production, sales and delivery and services of a business to maximize the volume of business and profits.

79. What is the purpose of inventory?

Traditional Supply Chain solutions such as Materials Requirement Planning , Inventory Control , typically focuses on implementing more rapid and efficient systems to reduce the cost of communicating information between and across the Inventory links in the SCM.COM focuses in optimizing the total investment of materials ...

80. What are the three categories of inventory costs?

Inventory costs are basically categorized into three headings:

- Ordering Cost.
- Carrying Cost.
- Shortage or stock out Cost & Cost of Replenishment. Cost of Loss, pilferage, shrinkage and obsolescence etc. Cost of Logistics. Sales Discounts, Volume discounts and other related costs.

Unit - V

81. What are network analysis techniques?

Network Analysis methods is a group of special analytical methods that are used in case where it is necessary to analyse and optimize a network of interconnected and related elements that have some connection between one another. Ishikawa diagram. PERT Method (Program Evaluation and Review Technique)

82. What is network analysis in business?

Critical path analysis ("CPA") is a widely-used project management tool that uses network analysis to help project managers to handle complex and time-sensitive operations.

83. What is activity in network analysis?

In the network diagram shown below, for the problem we considered before, each node (circle) represents an activity and is labelled with the activity number and the associated completion time (shown in brackets after the activity number). This network is an activity on node (AON) network.

84. What are network planning methods?

Network Planning methods - Methods used for network planning are: CPM , PERT .

Managing a project with network planning methods involves four steps:

- Describing the project.
- Diagramming the Network.
- Estimating time of completion.
- Monitoring project progress.

85. What is electronic network analysis?

A network, in the context of electronics, is a collection of interconnected components. Network analysis is the process of finding the voltages across, and the currents through, every component in the network. There are many different techniques for calculating these values.

86. What is network in network analysis?

A network, in the context of electronics, is a collection of interconnected components. Network analysis is the process of finding the voltages across, and the currents through, every component in the network. There are many different techniques for calculating these values.

87. What is network analysis in GIS?

Network Analysis in GIS is based on the mathematical sub-disciplines of graph theory and topology. Any network consists of a set of connected vertices and edges. Graph theory describes, measures, and compares graphs or networks. A simple example of a network in GIS can be streets, power lines, or city centrelines.

88. What is slack in network analysis?

In project management, float or slack is the amount of time that a task in a project network can be delayed without causing a delay to: subsequent tasks ("free float") project completion date ("total float").

89. What is event in network analysis?

Event chain methodology is an uncertainty modelling and schedule network analysis technique that is focused on identifying and managing events and relationship between them (event chains) that affect project schedules. It is the next advance beyond critical path method and critical chain project management.

90. What is event in network analysis?

Event chain methodology is an uncertainty modelling and schedule network analysis technique that is focused on identifying and managing events and relationship between them (event chains) that affect project schedules. It is the next advance beyond critical path method and critical chain project management.

91. Expand EST.

Earliest Start Time

92. Expand LST.

Late start Time

93. Expand EFT.

Earliest finish time

94. Expand TF.

Total Float

95. Expand FF.

Free Float

96. Expand IF.

Independent Float

97. What is Free Float?

Free Float is the amount of time that an activity can be delayed without delaying the early start date of any successor activity.

98. What is Independent Float?

Independent float is that portion of the total float within which an activity can be delayed for start without affecting the float of the preceding activities.

99. What is Total Float?

Total Float is the schedule flexibility or amount of time that a schedule activity can be delayed or extended without delaying the project finish date.

100. What is optimistic time in Pert?

There are three estimation times involved in PERT; Optimistic Time Estimate (TOPT), Most Likely Time Estimate (TLIKELY), and Pessimistic Time Estimate (TPESS). In PERT, these three estimate times are derived for each activity. This way, a range of time is given for each activity with the most probable value, TLIKELY

K3- LEVEL

UNIT- I

1. A company manufactures 3 type of product which use precious metals, platinum and gold. Due to the shortage of these metals, the government regulates the amount that may be used per day. The relevant data with respect to supply, requirement and profit are summarized in the table below:

Product	Platinum Required/unit (gms)	Gold Required/Unit (gms)	Profit/Unit (Rs.)
A	2	3	500
B	4	2	600
C	6	4	1200

Daily allotment of platinum and gold is 160 gms and 120 gms respectively. How should the company divide the supply of scarce precious metals? Formulate the mathematical model.

2. A dietician wishes to mix two type of food in such a way that the vitamin contents of the mixture contains at least 8 units of vitamin A and 10 units of vitamin B. Food I contains 2 units per kg of vitamin A and 1 unit per kg of vitamin B while the food II contains 1 unit per kg of vitamin A and 2 units per kg of vitamin B. It costs Rs.5 per kg to purchase food I and Rs.8 per kg to purchase food II. Prepare the mathematical model of the problem stated above.

3. Explain the Theorem of LPP.

4. A furniture dealer in only two items viz., tables and chairs. He has Rs.5,000 to invest and a space to store at most 60 pieces. A table costs him Rs.250 and a chair Rs.50. He can sell a table at a profit of Rs.50 and a chair at a profit Rs.15. Assuming that he can sell all the items that he buys, prepare a mathematical model of the problem stated above.

5. Give the restrictios

$$x \geq 0, y \geq 0$$

$$2x + y \leq 20$$

$$x + 2y \leq 20$$

Indicate the feasible region on a graph and maximise the function $x + 3y$.

6. Mark the feasible regions represented by constraint in equations.

$$x_1 + x_2 \leq 1$$

$$3x_1 + x_2 \geq 3$$

$$x_1, x_2 \geq 0 \text{ of a linear optimizing function } z = x_1 + x_2$$

7. Solve the following linear programming problems Graphical method.

Maximise $Z = 7x_1 + 3x_2$ subject to the constraints

$$2x_1 + 6x_2 \leq 24;$$

$$6x_1 + 2x_2 \leq 24;$$

$$x_1, x_2 \geq 0$$

8. Maximise $Z = 40x_1 + 50x_2$ subject to the constraints

$$3x_1 + x_2 \leq 9;$$

$$x_1 + 2x_2 \leq 8;$$

$$x_1, x_2 \geq 0$$

9. Minimise $Z = 10x_1 + 6x_2$ subject to the constraints

$$4x_1 + x_2 \geq 80;$$

$$2x_1 + x_2 \geq 60;$$

$$x_1, x_2 \geq 0$$

10. Explain the following terms with reference to linear programming:

i) objective function (ii) feasible solution (iii) optimal solution

UNIT - II

1. Describe a Transportation problem. 2. Find the starting solution of the following transportation model

	A	B	C	D	Available plant
X	10	22	10	20	8
Y	15	20	12	8	13
Z	20	12	10	15	11
Required	5	11	8	8	32

3. Solve the following transportation problem using NWCM.

	S1	S2	S3	Availability ai
W1	5	4	2	6
W2	4	7	6	8
W3	2	5	8	12
W4	8	6	7	14

Requirements bj	8	10	12	30
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4. Solve the following Transportation problem using Row Minimum Method.

	D1	D2	D3	D4	Destination
O1	1	2	1	4	30
O2	3	3	2	1	50
O3	4	2	5	9	20
Requirement	20	40	30	10	100

5. Solve the following transportation problem using Column Minimum Method.

	S1	S2	S3	S4	Availability
W1	5	2	4	3	22
W2	4	8	1	6	15
W3	4	6	7	5	8
Demand	7	12	7	19	45

6. Solve the following transportation problem using Least Cost Method.

	A	B	C	Ai
F1	10	9	8	8
F2	10	7	10	7
F3	11	9	7	9
F4	12	14	10	4
bj	10	10	8	28

7. Give the algorithm for obtaining an initial solution to a TP by least cost entry method

8. Determine an initial basic feasible solution to the TP Using NWCM.

	A1	B1	C1	D1	E1	Supply
A	2	11	10	3	7	4
B	1	4	7	2	1	8
C	3	9	4	8	12	9
Demand	3	3	4	5	6	21

9. Solve the following assignment problem using Row Minimum Method.

	1	2	3	Supply
A	2	7	4	5
B	3	3	1	8
C	5	4	7	7
D	1	6	2	14

Demand	7	9	18	34
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10. Solve the following transportation problem using North West Corner Method.

	D1	D2	D3	D4	Availability
O1	6	4	1	5	14
O2	8	9	2	7	16
O3	4	3	6	2	5
Requirement	6	10	15	4	35

UNIT - III

1. Find the optimal solution for the assignment problem with the following cost matrix.

	W	X	Y	Z
A	11	17	8	16
B	9	7	12	6
C	13	16	15	12
D	14	10	12	11

2. The secretary of a school is taking bids on the city's four school bus routes. Four companies have made the bids as detailed in the following tables:

	Bids			
	Route 1	Route 1	Route 1	Route 1
Company 1	Rs.40,000	Rs.40,000	-	-
Company 2	-	Rs.40,000	-	Rs.40,000
Company 3	Rs.40,000	-	Rs.40,000	-
Company 4	-	-	Rs.40,000	Rs.40,000

Suppose each bidder can be assigned only one route. Use the assignment model to minimize the school's cost of running the four bus routes.

3. Consider a problem of assigning four clerks to four tasks. The times (hours) required to complete the tasks are given below:

	Tasks			
Clerks	A	B	C	D
1	4	7	5	6
2	-	8	7	4
3	3	-	5	3

4	6	6	4	2
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Clerk 2 cannot be assigned to task A and clerk 3 cannot be assigned to task B. Find the optimum schedules.

4. There are 5 jobs, each of which must go through the two machines A and B in order A-B . Processing times (in hours) are given below :

JOB	1	2	3	4	5
Machine A	10	2	18	6	20
Machine B	4	12	14	16	8

Determine the sequence for the 5 jobs that will minimise the total elapsed time.

5. Following are printing and binding times of jobs on respective machines.

Book	1	2	3	4	5	6
Time for printing in Machine A (Hours)	5	7	2	6	3	4
Time for binding in Machine B(Hours)	2	5	4	9	1	3

6. Six jobs go first over machine I and then over machine II. The order of the completion of jobs has on significance. The following table gives the machine time in hours for six jobs and the two machines:

Job no	1	2	3	4	5	6
Time on machine I	5	9	4	7	8	6
Time on machine II	7	4	8	3	9	5

Find the sequence of jobs that minimises the total elapsed time to complete the jobs. Find the minimum time by using Gnatt's chart or by any other method. .

7. There are seven jobs, each of which has to go through the machine A and B in the order A-B . Processing time in hours are as follows:

Job	1	2	3	4	5	6	7
MA	3	12	15	6	10	11	9
MB	8	10	10	6	12	12	3

Determine the sequence of these jobs that will minimize the total elapsed time and find the idle time.

8. Explain the procedure for determining an optimal sequence.

9. Find the sequence that minimizes the total elapsed time (in hour) required to complete the following jobs on two machines M1 and M2 in the order M1-M2.

Job	A	B	C	D	E
M1	5	1	9	3	10
M2	2	6	7	8	4

Find also the idle time.

10. Explain maximisation problem in assignment.

UNIT- IV

1. Find the optimal ordering quantity for the following.

Annual usage	1000 pieces
Cost per piece	Rs. 250
Ordering cost	Rs. 6/order
Expediting cost	Rs. 4/order
Inventory holding cost	20% of average inventory

2. The annual demand for an item is 3200 units . The unit cost is Rs.6 and inventory carrying charges 25% per annum. If the cost of one procurement is Rs.150 , determine

- i) Economic order quantity
- ii) Number of order per year
- iii) Time between two consecutive order
- iv) The optimal cost(

3. Explain the types of inventory.

4. If the annual demand is Rs.600 units, the storage cost is Rs.0.60 per year per unit and the set up

cost is Rs.80 per run, find the optimum run size.

5. A company uses rivets at a rate of 5000 k per year, rivets costing Rs. 2.00/k. It costs Rs.20 to place an order and carrying cost of inventory is 10% per year. How frequently should the order of rivets be placed how much?

6. The demand for an item is a company is 18,000 units per year and the company can produce the item at a rate 3000 units per month. The cost of one setup is Rs.500 and the holding cost of one unit per month is 15 paise. Determine the optimum manufacturing quantity and the total cost per year assuming the cost of one unit is Rs.2.

7. A manufacturer has to supply his customer 24,000 units of his product per year. This demand is fixed and known. The customer has no storage space and so the manufacturer has

to skip a days supply each day. If the manufacturer fails to supply the penalty cost is Re.0.20 per unit per month. The inventory holding cost amounts to Re.0.10 per unit per month and the setup cost is Rs.350 per production run. Find the optimum lot size for the manufacturer.

8. A company has determined on an analysis of its accounting and production data of an item that its cost to purchase is Rs.36 per order and Rs.2 per part. Its inventory carrying charges is 18% of the average inventory. The demand of this item is 10,000 units per year. Find (i) What should be the EOQ and (ii) what is the optimum number of days supply per optimum order?

9. Explain types of control system.

10. An item is produced at the rate of 50 items per day. The demand occurs at the rate 25 items per day. If the set up cost is Rs. 100 per set up and holiday cost Re.01 per unit of item per day, find the economic lot size for one run assuming that the shortages are not allowed.

UNIT- V

1. The following tables gives the activities of a construction project and duration (in days)

Job	1-2	1-3	2-3	2-4	3-4	4-5
Duration	20	25	10	12	6	10

i) Draw the network diagram and find the critical path.

ii) Find the critical path and the project duration.

iii) Find the total float for each activity.

2. The following data are characteristics of a project

Activity	ImmediatePredecessors	Duration in days
A	-	2
B	A	3
C	A	4
D	B,C	6
E	-	2
F	E	8

i) Draw the network diagrams for the above project.

Find the minimum project completion time and the critical path.

3. The following table given the characteristics of a project.

Job	Predecessors	Duration(Days)
A	-	10
B	-	5
C	B	3
D	A,C	4
E	A,C	6
F	D	6
G	E	5
H	F,G	5

4.A project has the following characteristics and time estimate-optimistic time (a), most likely time (m) and pessimistic time (b). Construct a pert network. Find the critical path and the project duration.

Activity	a	b	m
1-2	1	5	1.5
2-3	1	3	2
2-4	1	5	3
3-5	3	5	4
4-5	2	4	3
4-6	3	7	5
5-7	4	6	5
6-7	6	8	7
7-8	2	6	4
7-9	4	8	6
8-10	1	3	2
9-10	3	7	5

5.A project has following characteristics.

Activity	Duration(weeks)	Predecessors
A	6	None
B	8	A

C	4	A
D	9	B
E	2	C
F	7	D

Construct the network and compute TE,TL for each and the critical path and project duration.

6.The following data are characteristics of a project

Activity	Duration	Preceding activity
A	4	-
B	9	-
C	3	A
D	8	B
E	7	B
F	2	D

Construct the network and finds the project and the critical path duration.

7. Explain time estimates.

8. A project consists of 9 jobs A to I with the following precedence relations and estimates of time . Draw a project network.

Job	A	B	C	D	E	F	G	H	I
Predecessor	-	-	A,B	A,B	B	D,E	C,F	D,E	G,H
Time(days)	15	10	10	10	5	5	20	10	15

9. A project has the following time schedule

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-6	5-8	6-9	7-8	8-9
Time in Month	2	2	1	4	8	5	3	1	5	4	3

Construct the network

i) Find the total float for each activity

ii) Find the critical path and the project duration.

10. Write the basic difference between PERT and CPM.

K4 & K5- LEVEL

Unit - I

1. A farmer has 1,000 acres of land on which he can grow corn, wheat or soya beans. Each acre of corn costs Rs.100 for preparation, requires 7 man-days of work and yields a profit of Rs.30. An acre of wheat costs Rs.120 to prepare requires 10 man-days of work and yields a profit of Rs.40. An acre of soya beans costs Rs.70 to prepare requires 8 man-days of work and yields a profit of Rs.20. If the farmer has Rs.1, 00,000 for preparation and can count on 80,000 man-days work, formulate the mathematical model.

2. A firm buys castings of P and Q type of part and sells them as finished product after machinery ,boring and polishing. The purchasing cost for castings are Rs.3 and Rs.4 each for parts P and Q and selling costs are Rs. 8 and Rs.10 respectively. The per hour capacity of machines used for machinery boring and polishing for two products is given below:

Capacity(per hour)	Parts	
	P	Q
Machinery	30	50
Boring	30	45
Polishing	45	30

The running costs for machinery, boring and polishing are Rs.30, Rs,22.5 and Rs.22.5 per hour respectively.

Formulate the LPP to find out the product mix to maximise the profit.

3. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs. 5760 to invest and has space at most for 20 items. A fan costs him Rs. 360 and a sewing machine Rs. 240. His expectation is that he can sell a fan at a profit of Rs. 22 and a sewing machine at a profit of Rs. 18. Assuming that he can sell all the items that he can buy, how should he invest this money in order to maximize his profit? Formulate this problem as a linear programming problem and then use graphical method to solve it.

4. Solve the following liner programming problems Graphical method.

Maximise $Z = 30x_1 + 20x_2$ subject to the constraints

$$10x_1 + 6x_2 \leq 1000;$$

$$5x_1 + 4x_2 \leq 6000;$$

$$x_1, x_2 \geq 0$$

5. Indicate on a graph paper the region satisfying the following restraints.

$$x \geq 0, y \geq 0$$

$$12x + 12y \leq 840$$

$$3x + 6y \leq 300$$

$$8x + 4y \leq 480$$

Under the above conditions maximise the function $5x + 7y$.

UNIT - II

1. Explain the various steps involved in North West Corner Rule.

2. Solve the following transportation model

	A	B	C	D	ai
X	10	18	11	7	20
Y	9	12	14	6	40
Z	8	9	12	10	35
bj	16	18	31	30	

3. Solve the following transportation problem using VAM Method.

Warehouse	S1	S2	S3	S4	Availability
A	5	1	3	3	34
B	3	3	5	4	15
C	6	4	4	3	12
D	4	1	4	2	19
Demand	21	25	17	17	80

4. Solve the following transportation model

	D1	D2	D3	D4	Availability
O1	10	18	11	7	6
O2	9	12	14	6	8
O3	8	9	12	10	10
Demand	4	6	8	6	24

5. Solve the following transportation problem using VAM Method.

	W1	W2	W3	W4	Capacity

F1	10	18	11	7	7
F2	9	12	14	6	9
F3	8	9	12	10	18
Required	5	8	7	14	

UNIT - III

1. Solve the following unbalanced assignment problem of minimizing total time for doing all

Operators	Job				
	1	2	3	4	5
1	6	2	5	2	6
2	2	5	8	7	7
3	7	8	6	9	8
4	6	2	3	4	5
5	9	3	8	9	7
6	4	7	4	6	8

the jobs.

2. Four jobs can be processed on four different machines, one job on one machine.

Resulting times in minutes vary with assignment. They are given below:

Job	Machine			
	A	B	C	D
I	42	35	28	21
II	30	25	20	15
III	30	25	20	15
IV	24	20	16	12

Find the optimum assignment of jobs to machines and the corresponding time.

3. Five jobs 1,2,3,4 and 5 are to be assigned to five persons A,B,C,D and E. The time taken (in minutes) by each of them on each job is given below :

	1	2	3	4	5
A	16	13	17	19	20
B	14	12	13	16	17
C	14	11	12	17	18
D	5	5	8	8	11

E	5	3	8	8	10
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Work out the optimal assignment and the total minimum time taken.

4. Find the sequence that minimises the total time in hours required to complete the following jobs on three machines.

Job	1	2	3	4	5	6	7
Machine I	4	9	8	5	10	9	8
Machine II	5	4	3	6	2	5	4
Machine III	7	8	6	12	6	7	13

What is the minimum elapsed time.

5. Find the sequence that minimizes the total elapsed time required to complete the following tasks on the machines in the order 1-2-3. Find also the minimum total elapsed time (hours) and the idle times on the machines.

Task	A	B	C	D	E	F	G
Machine 1	3	8	7	4	9	8	7
Machine 2	4	3	2	5	1	4	3
Machine 3	6	7	5	11	5	6	12

UNIT - IV

1. A manufacturer has to supply to his customer with 600 units of his products per year. Shortage is not allowed and storage cost amount to 60 paise per unit per year. The set up cost is Rs.80.00 find

- (i) the economic order quantity
- (ii) the minimum average yearly cost
- (iii) the optimum number of order per year.
- (iv) the optimum period of supply per optimum order.

2. Anil company buys its annual requirement of 36,000 units in six instalments. Each unit costs Rs. 1 and ordering cost is Rs.25 . The inventory carrying cost is estimated 20% of unit value. Find the total annual cost of the existing inventory policy. How much money can saved by using EOQ?

3. XYZ Company buys is lots of 2000 units which is only 3 months supply. The cost per unit is Rs. 125 and the ordering cost is Rs.250. The inventory carrying cost is 20% of unit value. How much money can be saved by using EOQ?

4. Following information in an inventory problem is available.

- Annual demand = 2400 units
 Unit price = Rs.2.40
 Ordering cost = Rs.4.00
 Storage Cost per piece = 2% per year

Interest rate = 10% per annum

Lead time = 1/2 month

Calculate EOQ, Reorder level and total annual inventory cost.

How much does the total annual cost vary if the unit price is changed to Rs.5

5. A Company , for one of the A- class items, placed 6 order each of size 200 in a year. Give ordering cost = Rs.600 ,holding cost = 40% , cost per unit = Rs.40. Find out the loss to the company in not operating scientific inventory policy?

UNIT - V

1. Construct PERT for network for the following project and determine the critical path and project duration.

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Duration in days	4	1	1	1	6	8	2	4	1	5	5	2
Predecessor	None	None	A	B	C	E	F	F	G	H, I	D, G	K

2. A project has the following schedules

Activity	A	B	C	D	E	F	G	H	I	J
Duration (weeks)	3	8	4	2	1	7	5	6	8	9
Predecessor	None	None	A, B	B	A	C	E, F	D, F	G, H	I

Construct the network and determine all the paths. Find the critical path and project duration.

3. A project consists of jobs. Draw a project network and determine the critical path.

Job	Duration
1-2	2
2-3	7
2-4	3
3-4	3
3-5	5
4-6	3
5-8	5
6-7	8
6-10	4
7-9	4
8-9	1
9-10	7

4. The utility data for a network is given below. Determine the total ,free independent floats and identify the critical path.

Activity	0-1	1-2	1-3	2-4	2-5	3-	3-	4-	5-	6-
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						4	6	7	7	7
Duration	2	8	10	6	3	3	7	5	2	8

5. A project scheduling has the following characteristics.

Activity	1	1	2	3	3	4	5	5	6	7	8	9
	-	-	-	-	-	-	-	-	-	-	-	-
	2	3	4	4	5	9	6	7	8	8	1	1
											0	0
Duration	4	1	1	1	6	5	4	8	1	2	5	7

Summarise the CPM calculations in a tabular form and determine the critical path.