

P.G DEPARTMENT OF COMPUTER APPLICATIONS

19PMC317 - RESOURCE MANAGEMENT TECHNIQUES

K1 LEVEL QUESTIONS

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

A. economical C. a and b both

B. **scientific** D. artistic

2. Feasible solution satisfies _____

A. Only constraints C. **[a] and [b] both**

B. only non-negative restriction D. [a],[b] and Optimum solution

3. In Degenerate solution value of objective function _____.

B. decreases infinitely D. **One or more basic variables are zero**

4. Minimize $Z =$ _____

A. $-\text{maximize}(Z)$ C. **$-\text{maximize}(-Z)$**

B. $\text{maximize}(-Z)$ D. none of the above

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

A. 2 C. not more than 3

B. 3 D. **none of the above**

6. In graphical representation the bounded region is known as _____ region.

A. Solution C. basic solution

B. **feasible solution** D. optimal

7. Graphical optimal value for Z can be obtained from

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

8. In LPP the condition to be satisfied is

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

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

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

10. 12. The linear function of variables which is to be maximized or minimized is called

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

Unit II

11. North – West corner refers to _____.

- A. **top left corner** C. both of them
B. top right corner D. none of them

12. The _____ method's solution for transportation problem is sometimes an

optimal solution itself.

A. NWCM C. LCM

B. **VAM** D. Row Minima

13. In Assignment Problem the value of decision variable x_{ij} is_____.

A. no restriction C. **one or zero**

B. two or one D. none of them

14. From the following methods _____ is a method to obtain initial solution to Transportation Problem.

A. **North-West** C. Hungarian

B. Simplex D. Newton Raphson

15. The Penalty in VAM represents difference between _____ cost of respective row / column.

A. Two Largest C. largest and smallest

B. **smallest two** D. none of them

16. Number of basic allocation in any row or column in Assignment Problem can be

A. **Exactly one** C. at least one

B. at most one D. none of them

17. If number of sources is not equal to number of destination in Assignment problem then it is called _____.

A. **unbalanced** C. unsymmetric

B. symmetric D. balanced

18. The _____ method used to obtain optimum solution of travelling salesman problem.

A. Simplex C. dominance

B. **Hungarian** D. graphical

19. The solution to a transportation problem with m-rows and n-columns is feasible if number of positive allocations are

A. $m+n$ C. $m + n -1$

B. $m \times n$ D. all of the above

20. The calculation of opportunity cost in the MODI method is analogous to a

A. **$c_j - z_j$ value for non-basic variable columns in the simplex method**

B. value of a variable in b-column of the simplex method

C. variable in xb-column

D. all of the above

Unit III

21. Activity which starts only after finishing other activity is called _____.

A. dummy C. **successor**

B. Predecessor D. none of them

22. Burst and Merge are types of _____ in networking.

A. **event** C. arrow

B. activity D. tools

23. Activity which does not require any resources or time is called _____.

A. **dummy** C. successor

B. Predecessor D. none of them

24. Event indicates _____ of activity.

A. starting C. **both A and B**

B. ending D. none of them

25. _____ is indicated by dotted arrow.

A. burst event C. **dummy activity**

B. merge event D. none of them

26. _____ event represents beginning of more than one activities.

- A. **burst** C. dummy
- B. merge D. none of them

27. Merge event represents _____ of two or more events.

- A. beginning C. splitting
- B. **completion** D. none of them

28. Activity which is completed before starting new activity is called_____.

- A. dummy C. successor
- B. **predecessor** D. none of them

29. Network models have advantage in terms of project

- A. Planning C. Controlling
- B. Scheduling **D. All of the above**

30. The slack for an activity is equal to

- A. LF-LS **C. LS-ES**
- B. EF-ES D. None of the above

Unit IV

31. The operations Research technique which helps in minimizing total waiting and service costs is

- a) **Queuing Theory**

b) Decision Theory

c) Both A and B

d) None of the above

32. What aims at optimizing inventory levels?

a) Inventory Control b) Inventory Capacity

c) **Inventory Planning** d) None of the above

33. The traffic intensity for M/M/1 system is given by _____.

a. $\rho = \lambda / \mu$. b. $\rho = \mu / \lambda$. c. $\rho = \lambda \mu$. d. None of these

34. For M/M/1 queueing system if arrival rate is 10 customers/day and service rate is 30 customers per day then expected number of customers in the queue on a certain day is _____.

a. **1/3**. b. 1/6. c. 6. d. None of these.

35. If arrival rate is 20 customers/week and service rate is 50 customers/week, then the expected number of busy servers for M/M/1 queueing system are _____.

a. **2/5**. b. 5/2. c. 5. d. None of these

36. For M/M/1 model the expected number of busy servers are equal to _____.

a. **Traffic intensity ρ** . b. Arrival rate λ . c. Service rate μ . d. None of these

37. Consider the situation, when no server is working, then the number of customers in the system are _____.

a. **Equal to number of customers in queue**. b. More than number of customers in queue. c. Less than number of customers in queue. d. None of these

38. Let λ be an arrival rate of customer in a system, μ be an service rate of the system then the expected number of busy servers are _____.

a. λ / μ . b. $\lambda + \mu$. c. $\lambda \mu$. d. None of these.

39. The departure and arrivals in queuing system are normally considered respectively M/M/1 the arrival and departure distribution are _____.

a. **Both Markovian** . b. Binomial. c. General. d. None of these.

40. Consider the situation, when no server is working, then the number of customers in the system are_____.

a. **Equal to number of customers in queue.** b. More than number of customers in queue. c. Less than number of customers in queue. d. None of these.

UNIT V

41.Replacement Model is a ----- model

a) Static Models

b) **Dynamic Models**

c) Both A and B

d) None of the above

42.What is concerned with the prediction of replacement costs and determination of the most economic replacement policy ?

a) Search Theory

b) **Theory of replacement**

c) Probabilistic Programming

d) None of the above

43.What is concerned with the prediction of replacement costs and determination of the most economic replacement policy ?

a) Search Theory b) **Theory of replacement**

c) Probabilistic Programming d) None of the above

44. ----- models involves the allocation of resources to activities in such a manner that some measure of effectiveness is optimized.

a) **Sequencing** b) Allocation Models c) Queuing Theory d) Decision Theory

45. The group replacement policy is suitable for identical low cost items which are likely to

(a) Fail over a period of lime

- (b) Fail suddenly
- (c) **Fail completely and suddenly**
- (d) None of these

46. The problem of replacement is felt when job performing units fall

- (a) Suddenly (b) **Gradually** (c) (a) and (b) both (d) None of these

P.G DEPARTMENT OF COMPUTER APPLICATIONS

19PMC317 - RESOURCE MANAGEMENT TECHNIQUES

K2 LEVEL QUESTIONS

UNIT I

1. List out the applications of operations research. Operation research is useful for solving

(i) Resource allocation problems (ii) Inventory control problems (iii) maintenance and replacement problems (iv)sequencing and scheduling problems (v) maximize total profit or minimize total coast

2. What is the role of O.R in Engineering?

(i) Optimal design of water resources systems(ii) Optimal design of structures(iii) Production, Planning, Scheduling and control(iv) Optimal design of electrical networks(v) Inventory control(vi) Planning of maintenance and replacement of equipment(vii) Allocation of resources of services to maximize the benefit(viii) Design of material handling(ix) Optimum design of machines(x) Optimum design of control systems

3. What is linear programming?

Linear programming problems deal with determining optimal allocations of limited resources to meet given objectives. The resources may be in the form of men, raw materials, market demand, money and machines etc. The objective is usually maximizing profit, minimizing total cost maximizing utility etc. There are certain restrictions on the total amount of each resource available and on the quantity or quality of each product made.

4. What is static model?

This is a mode which does not take time into account. It assumes that the values of the variables do not change with time during a certain period of time horizon. Example: A linear programming problem, an assignment problem, transportation problem etc.

5. Define O.R.

Operations Research is the application of scientific methods, techniques and tools to operations of systems to obtain optimal solution to the problems, it provides a quantitative technique to the managers for making better decisions for operations under control

6. What is an assignment problem?

Given n facilities and n jobs and given the effectiveness of each facility for each job, the problem is to assign each facility to one and only job so as to optimize the given measure of effectiveness.

7. What is an unbalanced assignment problem?

An assignment problem is an unbalanced problem if the number of jobs is not equal to no. of facilities. The Hungarian method of solution requires a square matrix. Hence fictitious facilities or jobs are added and assigned 0 costs to the corresponding cells of the matrix. These cells are treated the same way as the real cost cells during the solution procedure.

8. What are the basic assumptions?

(i) Proportionality (ii) Additivity (iii) Divisibility (iv) Certainty or Deterministic (v) Finiteness (vi) Optimality

9. When does degeneracy happen in transportation problem?

In transportation problems, whenever the number of negative independent allocations is less than $m+n-1$, the transportation problem is said to be a degenerate one. Degeneracy may occur either at the initial stage or at an intermediate at some subsequent iteration.

10. What are the two types of integer programming?

Pure integer programming and mixed integer programming are the two types of integer programming.

The maximization problem, can be solved by converting it into minimization problem by subtracting all the cell values from the largest cost/profit in the matrix.

UNIT II

11. Define a transportation problem.

It is a special kind of linear programming problem in which goods are transported from a set of sources to a set of destinations subject to the supply and demand of the source and destination, respectively, such that the total cost of transportation is minimized.

12. Write down the mathematical model for transportation problem.

Let m be the number of sources, n be the number of destinations, a_i be the supply at the source i , b_j be the demand at the destination j , c_{ij} be the cost of transportation per unit from source i

to destination j . Let X_{ij} be the number of units to be transported from the source i to the destination j .

Refer notes by me for the mathematical model.

13. Differentiate between balanced transportation problem and unbalanced transportation problem.

Balanced transportation problem: If the sum of the supplies of all the sources is equal to the sum of the demands of all the destinations, then the problem is termed as balanced transportation problem.

i.e., $\sum a_i = \sum b_j$ for all for all $i = 1$ to m and $j = 1$ to n .

Unbalanced Transportation Problem: If the sum of the supplies of all the sources is not equal to the sum of the demands of all the destinations, then the problem is termed as unbalanced transportation problem.

i.e., $\sum a_i \neq \sum b_j$ for all for all $i = 1$ to m and $j = 1$ to n .

14. Mention the various methods of finding initial basic feasible solution to a transportation problem.

- Northwest Corner method
- Least cost cell method
- Vogel's approximation method [Penalty method]

15. How can you resolve an unbalanced transportation problem?

An unbalanced transportation problem can be resolved by adding a dummy row with zeroes is added as an additional source, if the total demand is greater than the total source.

A dummy column with zeroes is added as an additional destination, if the total source is greater than the total demand.

16. What do you mean by degeneracy in a transportation problem? How can you resolve it?

Degeneracy occurs when the number of basic cells are less than $(m+n-1)$, where m is the number of sources and n is the number of destinations.

Degeneracy can occur either during initial solution or during iterative process. For both the cases, allocate an infinitesimally small quantity ϵ , to any independent unoccupied cell and proceed as if it is a basic cell.

17. Write the method of forming a loop in transportation problem.

Identify the non-basic cell, which has the maximum positive penalty and term that as the new basic cell. Starting from the new cell, draw a closed loop consisting of only horizontal and vertical lines passing through some basic cells.[The change of direction of the loop should be with 90° only at some basic cell].Starting from the new basic cell, alternatively assign positive and negative signs at the corners of the closed loop.

18. Mention some of the special cases of transportation problem.

- Unbalanced TP
- Alternative optimal solution
- Prohibited transportation routes
- Maximization transportation problem.

19. What do you mean by Prohibited transportation problem.

Situation may arise such as road hazards such as snow, flood etc traffic regulations, when it is not possible to transport goods from certain sources to certain destinations. Such problems can be handled by assigning a very large cost say M to that route/cell.

20.How do you solve a maximization transportation problem?

The maximization problem, can be solved by converting it into minimization problem by subtracting all the cell values from the largest cost/profit in the matrix.

UNIT III

21. What is dummy activity in operation research?

Dummy activities often have a zero completion time and are used to represent precedence relationships that cannot be easily (if at all) represented using the actual activities involved in the project. By convention dummies are always shown as dotted arcs in network diagrams.

22. What is activity in network analysis?

A quality management tool that charts the flow of activity between separate tasks. It graphically displays interdependent relationships between groups, steps, and tasks as they all impact a project. Bubbles, boxes, and arrows are used to depict these activities and the links between them.

23. What is the difference between PERT and CPM?

PERT is a technique of planning and control of time. Unlike CPM, which is a method to control costs and time. While PERT is evolved as a research and development project, CPM evolved as a construction project. PERT is set according to events while CPM is aligned towards activities.

24. What is network method?

Network Analysis methods is a group of special analytical methods that are used in case where it is necessary to analyze and optimize a network of interconnected and related elements that have some connection between one another

25. What are the advantages of critical path analysis?

The increase of efficiency also saves money. Since the critical path method is all about scheduling more efficiently and getting resources to the right place at the right time, there's less of a chance for unexpected delays that cost time and money to fix.

26. What is pert and its applications?

Pert and its applications. ... Program (Project) Evaluation and Review Technique (PERT): is a project management tool used to schedule, organize, and coordinate tasks within a project

27. What is event in network analysis?

An unbroken chain of activities between any two events is called a path. Event. An event represents the accomplishment of some task.

28. What is the use of PERT technique?

A PERT chart is a project management tool used to schedule, organize, and coordinate tasks within a project. PERT stands for Program Evaluation Review Technique, a methodology developed by the U.S. Navy in the 1950s to manage the Polaris submarine missile program.

29. Is Critical Path the longest or shortest?

In project management, a critical path is the sequence of project network activities which add up to the longest overall duration, regardless if that longest duration has float or not. This determines the shortest time possible to complete the project.

30. What is a critical activity?

Critical path activities are the project tasks that must start and finish on time to ensure that the project ends on schedule.

UNIT IV

31. What is a queuing problem?

Queuing theory is the study of how systems cope with a variable demand for service. Queuing problems occur when the service doesn't match the level of demand, for example when a supermarket doesn't have enough cashiers on a busy morning.

32. What is queuing theory and why is there waiting?

According to him, the queuing theory applies to those situations where a customer comes to a service station to avail the services and wait for some time (occasionally) before availing it and then leave the system after getting the service.

33. What are the applications of queuing theory?

Many valuable applications of the queuing theory are traffic flow (vehicles, aircraft, people, communications), scheduling (patients in hospitals, jobs on machines, programs on computer), and facility design (banks, post offices, supermarkets).

34. What do you mean by inventory control?

Definition of inventory control. : coordination and supervision of the supply, storage, distribution, and recording of materials to maintain quantities adequate for current needs without excessive oversupply or loss.

35. What are the queueing disciplines?

FIFO, LIFO, RANDOM, SIRO

36. How do you calculate interarrival time?

Usually, the timing of arrivals is described by specifying the average rate of arrivals per unit of time (λ), or the average interarrival time ($1/\lambda$). For example, if the average rate of arrivals, $\lambda = 10$ per hour, then the interarrival time, on average, is $1/\lambda = 1/10$ hr = 6 min.

37. What is average queue length?

This is the average number of customers in the system. (Better: This is the average number of customers waiting in the system to get service....) Average delay time T . The delay is defined as: The average delay time is the average amount of time that a customer spends in the system.

38. What is service time?

In queuing system, service time is defined as the time required to serve a customer. The reciprocal of average service time is termed as mean service rate and is defined as number of customers served during a fixed time period

39. What does queuing traffic mean?

Queueing and Traffic Flow is the study of traffic flow behaviors surrounding queueing events. It combines elements from the previous two sections, Queueing and Traffic Flow.

40. What is the waiting line problem?

The waiting line or queue management is a critical part of service industry. It deals with issue of treatment of customers in sense reduce wait time and improvement of service. Queue management deals with cases where the customer arrival is random; therefore, service rendered to them is also random.

UNIT V

41. What is replacement?

The Replacement Theory in Operations Research is used in the decision making process of replacing a used equipment with a substitute; mostly a new equipment of better usage. The replacement might be necessary due to the deteriorating property or failure or breakdown of particular equipment.

42. What is individual replacement?

Individual replacement policy. In this policy a particular time 't' is fixed to replace the item whether it has failed or not. It can be done when one knows that an item has been in service for a particular period of time and has been used for that time period.

43. What is Group replacement?

if all the street lights in a particular cluster are replaced as and when. They fail and also simultaneously in groups, then the policy is called as 'Group.Replacement'.

44. What do you mean by replacement model?

Replacement models are concerned with the problem of replacement of machines, individuals, capital assets, etc. due to their deteriorating efficiency, failure, or breakdown. It is evident that the study of replacement is a field of application rather than a method of analysis.

45. What do you mean by sequencing problem?

Sequencing problems in Operations Research. ... It is the selection of an appropriate order in which a number of jobs (Operations) can be assigned to a finite number of service facilities (Machines or equipments) so as to optimize the outputs in terms of time, cost or profit.

46. What do you mean by job sequencing?

Sequencing can be defined as the selection of an order for a series of jobs to be done on a number of service facilities (machine). ... The purpose of sequencing problems is to complete the job within the minimum possible time, keeping the minimum idle time of the machines (or services).

47. What is priority sequencing?

Five priority sequencing rules are: n First come, first served (FCFS); or First in, first out (FIFO): Jobs are sequenced in the order in which they arrive at the workstation. n Earliest due date (EDD): Jobs are sequenced in the order in which they are due for delivery to the customer.

48. What is job sequencing with deadline problem?

Problem Statement. In job sequencing problem, the objective is to find a sequence of jobs, which is completed within their deadlines and gives maximum profit.

49. What is sequencing in operations management?

Sequencing refers to the order in which activities occur in the operations process. ... It forces the operations manager to carefully plan the operations process. Each task needs to be broken down into smaller tasks. It is then easier to see where the business can be more effective

50. What is the difference between sequencing and scheduling?

Sequencing is the order of tasks to be done in chain. Hence the next task is started once the previous one is completed. Scheduling, on the other hand is the process in which people are assigned to time to accomplish different tasks. It improves the delivery performance and reduces the manufacturing time and cost

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K3 LEVEL QUESTIONS

UNIT I

1. Define OR? What are the different phases in Operations Research? Describe briefly its applications.
2. Define artificial variable. Why do we need them?
3. Prove that dual of the dual is the primal?
4. Define degeneracy. Narrate the procedure to deal with the problem of degeneracy in LPP?
5. What are the various replacement models?
6. Advantages of OR study.
7. Disadvantages of OR study
8. Solve the following LP graphically:
Maximize $z = 8000x_1 + 7000x_2$
Subject to $3x_1 + x_2 \leq 66$
 $x_1 + x_2 \leq 45$
 $x_1 \leq 20$
 $x_2 \leq 40$
 $x_1, x_2 \geq 0$
9. Solve by Big M method Maximize $Z = 3x_1 - x_2$
Subject to $2x_1 + x_2 \geq 2$, $x_1 + 3x_2 \leq 3$, $x_1, x_2 \geq 0$
10. Solve by Big M method Maximize $Z = 3x_1 - x_2 + 4x_3$
Subject to $3x_1 - x_2 - x_3 \leq -2$, $5x_1 + 2x_2 \geq -3$, $x_1, x_2, x_3 \geq 0$

UNIT II

11. Explain North-West corner rule.
12. What is a transportation problem?
13. Distinguish between a balanced and an unbalanced transportation problem.
14. What is the difference between a assignment problem and a traveling salesman problem?
15. Give two areas for the application of assignment problem
16. Obtain the initial solution to above TP using VAM method.

	A	B	C	D	Supply
I	1	5	3	3	34
II	3	3	1	2	15
III	0	2	2	3	12
IV	2	7	2	4	19
Demand	21	25	17	17	

17. Solve the following Assignment Problems.

	P	Q	R	S
B	18	33	9	31
C	44	25	24	21
D	23	30	28	14

18. Solve the following Assignment Problems.

	I	II	III	IV
1	11	10	18	5
2	14	13	12	19
3	5	3	4	2
4	15	18	17	9

19. Solve the following Assignment Problems.

	A	B	C	D	E	F
1	13	13	16	23	19	9
2	11	19	26	16	17	18
3	12	11	4	9	6	10
4	7	15	9	14	14	13
5	9	13	12	8	14	11

20. Solve the following Assignment Problems

	P	Q	R	S
A	5	3	4	7
B	2	3	7	6
C	4	1	5	2
D	6	8	1	2

UNIT III

21. Differentiate between CPM Network and PERT Network.

22. Construct PERT network and find the critical path and its duration?

23. What are the activity durations in PERT? What is the distribution of the activity duration?

24. Find its mean and variance.

25. Define terms: Activity, Event, Merge Event, Burst Event

26. Define Total float, Free float, Independent float, Critical path

27. State Rules for Network Diagram.

28. Write disadvantages of Network techniques.
29. What is Dynamic Programming Problem?
30. State the principle of optimality in dynamic programming.

UNIT IV

31. Gives a brief description of the various types of queues
32. What is inventory management?. Briefly, explain the major decisions concern-carrying inventory.
33. Discuss the impact on Economic Order Quantity if shortages are allowed.
34. Write some important applications of queuing theory.
35. Define the terms i. Inventory ii. Economic Order Quantity iii. Lead time.
36. Explain the method of determining the EOQ with a single price breaks?
37. Find the optimum order quantity for a product for which the price breaks are as follows

Quantity	unit price(Rs)
$0 \leq Q_1 < 800$	1.00
$800 \leq Q_2$	0.98

The yearly demand for the product is 1600 units per year, cost of placing an order is Rs 5 and cost of storage is 10% per year.

38. A company has a steady demand of a product of 40 items per month. The purchase cost is Rs 6 per item and the cost of ordering and procuring the material is Rs 15 per occasion. If stock holding cost is 20% per annum. How frequently should the company replenish the stock?
39. In a super market the average arrival rate of customers is 5 every 30 minutes. The average time it takes to list and calculate the customer's purchases at the cash desk is 4.5 minutes, find how long will the customer expect to wait for service at the cash desk? And what is the chance that the queue length is exceed 5?
40. The demand of an item is uniform , at a rate of 25 unit per month. The fixed cost is Rs.15 each time a production run is made. The production cost is Rs.1 per item and the inventory carrying cost is Rs.0.30 per item per month. If the shortage cost is Rs.1.50 per item per month, determine the frequency and size of the production run that is to be made.

UNIT V

41. Explain a general replacement problem?
42. What is sequencing problem? State the assumptions of it . Give an example.
43. What are the various replacement models?
44. Write the Johnson algorithm for solving a sequencing problem.
45. difference between individual and group replacement policy

46. A machine shop 8 different products are being manufactured each requiring time on two different machines A and B are given in the table below:

Product 1 2 3 4 5 6 7 8

Machine-A 30 45 15 20 80 120 65 10

Machine B 20 30 50 35 35 40 50 20

Find an optimal sequence of processing of different product in order to minimize the total manufactured time for all product. Find total ideal time for two machines and elapsed time.

47. In a machine shop 6 different products are being manufactured each requiring time on two different machines A and B are given in the table below:

Product 1 2 3 4 5 6

Machine-A 30 120 50 20 90 110

Machine B 80 100 90 60 30 80

Find an optimal sequence of processing of different product in order to minimize the total manufactured time for all product. Find total ideal time for two machines and elapsed time.

48. In a printing shop 7 different books are printed and bounded on two different machines A and B. Time required on two machines are given in the table below:

Product 1 2 3 4 5 6 7

Printing 3 4 8 3 6 7 5

Binding 8 6 3 7 2 8 4

Find an optimal sequence of processing of different product in order to minimize the total manufactured time for all product. Find total ideal time for two machines and elapsed time.

49. Solve the following sequencing problem giving an optimal solution when passing out is not allowed.

Machine

Job

A B C D E

M1 11 13 9 16 17

M2 4 3 5 2 6

M3 6 7 5 8 4

M4 15 8 13 9 11

50. Using graphical method, Calculate the minimum time needed to process jobs 1 and 2 on five machines A, B, C, D & E, i.e. for each machine find the job which should be done first. Also calculate the total elapsed time to complete both the jobs.

Job 1 Machine Sequence A B C D E

Time (hrs) 6 8 4 12 4

Job 2 Machine Sequence B C A D E

Time (hrs) 10 8 6 4 12

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K4K5 LEVEL QUESTIONS

UNIT I

1. A firm manufactures two products A and b on which the profits earned per unit are Rs 3 and Rs 4 respectively. Each product is processed on two machines M1 and M2. Product A requires one minute of processing time on M1 and two minutes on M2 while B requires one minute on M1 and one minute on M2. Machine M1 is available for not more than 7 hours, while machine M2 is available for 10 hours during any working day. Formulate the number of units of products A and B to be manufactured to get maximum profit.
2. Write the steps for solving Linear Programming Problem by Graphical method. State its limitations.
3. Solve the following LP problems graphically
Minimize $Z = 3x_1 + 2x_2$
Subject to $5x_1 + x_2 \geq 10$, $x_1 + x_2 \geq 6$, $x_1 + 4x_2 \geq 12$, $x_1, x_2 \geq 0$
4. Solve the following LP problems graphically
Maximize $Z = 30x_1 + 20x_2$
Subject to $3x_1 + 3x_2 \geq 40$
 $2x_1 + 5x_2 \geq 44$
 $x_1, x_2 \geq 0$
5. Find the solution using graphical method
Max $z = 3x_1 + 5x_2$
 $x_1 + 2x_2 \leq 2000$
 $x_1 + 2x_2 \leq 1500$
 $x_2 \leq 600$
 $x_1, x_2 \geq 0$

UNIT II

6. Explain lowest cost entry method for obtaining an initial basic solution of a transportation problem?
7. State the mathematical model of an assignment problem?
8. Solve by using northwest corner method.

	D1	D2	D3	D4	Supply
O1	6	4	1	5	14
O2	8	9	2	7	16
O3	4	3	6	2	5

Dem. 6 10 15 4

9. Obtain the initial solution to above TP using least cost method.

	A	B	C	D	Supply
I	6	3	5	4	22
II	5	9	2	7	15
III	5	7	8	6	8
Demand	7	12	17	9	

10. Obtain the initial solution to above TP using least cost method.

	D1	D2	D3	D4	Supply
O1	1	2	3	4	6
O2	4	3	2	0	8
O3	0	2	2	1	10
Demand	4	6	8	6	

UNIT III

11. Write assumptions of sequencing problems.
 12. A project has the following time schedule:

Activity Time

In month

1-2 2 3-6 8 6-9 5

1-3 2 3-7 5 7-8 4

1-4 1 4-6 3 7-9 3

2-5 4 5-8 1

Construct PERT network and compute total float for each activity. Find Critical path with its duration.

13. Draw the Network Diagram for the following activities and find the critical path.

Job A B C D E F G H I J K

Job time(days) 13 8 10 9 11 10 8 6 7 14 18

Immediate predecessors - A B C B E D, F E H G, I J

14. A project has the following time Schedule. Construct a PERT network and compute Critical Path and its duration. Also calculate Total float, Free float.

Activity 1-2 1-3 2-4 3-4 3-5 4-9 5-6

Time in Weeks 4 1 1 1 6 5 4
 Activity 5-7 6-8 7-8 8-9 8-10 9-10
 Time in Weeks 8 1 2 1 8 7

15. A project schedule has the following characteristics. Construct the PERT network and find the critical path and time duration of the project.

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

UNIT IV

16. The annual consumption of an item is 2000 units. The ordering cost is Rs.100 per order. The carrying cost is Rs.0.80 per unit, per year. Assuming working days as 200, lead time as 20 days, and safety stock as 100 units, calculate i) EOQ, ii) The number of orders per year.

17. For a fixed order quantity, determine i)EOQ, ii) Optimum buffer stock.

Annual consumption, $R=10,000$ units, cost of one unit = Rs.1, $C_3= Rs.12$ per production run, $C_1=0.24$ per unit. Maximum lead time =30 days and normal lead time =15 days.

18. A particular item has an annual demand of 9000 units. The carrying cost is Rs.2 per unit, per year. The ordering cost is Rs.90. Find i)EOQ ii) Determine the number of orders to be placed per annum.

19. Calculate EOQ and buffer stock from the following data. Annual consumption is 12000 units at the cost of Rs.7.50 per unit. Set up cost is Rs.6 and the average inventory holding cost is Rs.0.12 per unit. Normal lead time is 15 days and maximum lead time is 20 days

20. The annual demand for the product is 10,000 units, Each unit costs Rs.100 for orders placed in quantities below 200 units but for orders of 200 or above the price is Rs.95. The annual inventory holding cost is 10 percent of the value of the item and the ordering cost is Rs.5 per order. Find the economic lot size. The cost of storage is 2 percent of the unit cost and the cost of ordering is Rs.500 per order. Find the economic lot size?

UNIT V

21. we have 5 jobs each of which must go through the two machines A and B in the order A,B.processing time in hours are given in the table below

Job	1	2	3	4	5
Machine 1	5	1	9	3	10
Machine 2	2	6	7	8	4

Determine a sequence for the five jobs that will minimize the elapsed time.

22. A firm is considering replacement of a machine, whose cost price is Rs.12200 and the scrap value is Rs.200. the maintenance cost in Rupees are found from experience to be as follows:

Years	:	1	2	3	4	5	6	7	8
Maintenance cost:		200	500	800	1200	1800	2500	3200	4000

When should the machine be replaced?

23. Explain the S.M. Johnson rule with example

Job	:	1	2	3	4	5
Machine A	:	5	1	9	3	10
Machine B	:	2	6	7	8	4

Fine the Minimum elapsed time , Idle time for Machine A and Idle time for Machine B

24.	Job	Processing time		
		A	B	C
	1	40	50	80
	2	90	60	100
	3	80	20	60
	4	60	30	70
	5	50	40	110

Determine a sequence for the five jobs that will minimize the elapsed time T

25. A manufacturer is offered two machines A and B. A is priced at Rs.50,000 and running costs are estimated at Rs.8000 for each of the first five years, increasing by 2000 per year in the sixth and subsequent years. Machine B of the same capacity costs Rs. Rs.25,000 but will have running costs of Rs.12000 per year for six years increasing by Rs.2000 per year thereafter. If money is worth 10% per year, which machine should be purchased?