

DEPARTMENT OF MECHANICAL ENGINEERING
MEE6015 - OPERATION RESEARCH

TWO MARK QUESTIONS WITH ANSWERS

YEAR: IV - MECH

SEMESTER: VIII

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 cost.

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 analytic procedure?

Solving models by classical mathematical techniques like differential calculus, finite differences etc. to obtain analytic solutions.

4. What is Iterative procedure?

Starts with a trial solution and a set of rules for improving it by repeating the procedure until further improvement is not possible.

5. What is monte-carlo technique?

Taking sample observations, computing probability distributions for the variable using random numbers and constructing some functions to determine values of the decision variables.

6. What are the limitations for operation research?

Mathematical models which are the essence of OR do not take into account qualitative or emotional or some human factors which are quite real and influence the decision making. All such influencing factors find no place in O.R. This is the main limitation of O.R. Hence O.R. is only an aid in decision making.

7. 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.

8. What are the characteristics of linear programming problem?

- (i) It should be reasonably simple
- (ii) A good model should be capable of taking into account new changes in the situation affecting in the situation affecting its frame significantly with ease i.e., updating the models should be as simple and easy as possible.
- (iii) Assumptions made to simplify the model should be as small as possible
- (iv) Number of variables used should be as small in number as possible
- (v) The model should be open to parametric treatment.

9. List any four classifications of models in operation research

The first thing one has to do to use O.R. techniques after formulating a practical problem is to construct a suitable model to represent the practical problem. A model is a reasonably simplified representation of a real-world situation. It is an abstraction of reality. The models can broadly be classified as Iconic (Physical) Models, Analogue Models, Mathematical Models, Static Models.

10. What is the analogue or schematic models?

This uses one set of properties to represent another set of properties which a system under study has Example: A network of water pipes to represent the flow of current in an electrical network or graphs, organizational charts etc.

11. What is Mathematical Model or Symbolic Model?

This uses a set of mathematical symbols (letters, numbers etc) to represent the decision variables of a system under consideration. These variables related by mathematical equations which describes the properties of the system.

Example: A linear programming model, A system of equations representing an electrical network or differential equations representing dynamic system etc.

12. What is static model?

This is a model 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.

13. List any four principles of modeling?

- (i) Do not build up a complicated model while a simple one will suffice.
- (ii) Beware of moulding the problems to fit a (favourite !) technique
- (iii) Deductions must be made carefully
- (iv) Models should be validated prior to implementation.

14. List any four requirements of employing linear programming problem techniques.

- (i) There must be a well-defined objective function.
- (ii) There must be alternative courses of action to choose.
- (iii) At least some of the resources must be in limited supply, which give rise to constraints
- (iv) Both the objective function and constraints must be linear equations or inequalities.

15. What is the Procedure for forming a Linear Programming Problems Model?

- (i) Identify the unknown decision variables to be determined and assign symbols to them.
- (ii) Identify all the restrictions or constraints (or influencing factors) in the problem and express them as a linear equations or inequalities of decision variables.
- (iii) Identify the objective or aim and represent it also as a linear function of decision variables.
- (iv) Express the complete Linear Programming Problems models as a general mathematical model.

16. 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

17. 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.

18. 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.

19. What are the basic assumptions?

The linear programming problems are solved on the basis of the following assumptions.

Proportionality

Additivity

Divisibility

Certainty or Deterministic

Finiteness

Optimality

20. What are the advantages of linear programming?

(i) It provides an insight and perspective in to the problem environment. The generally results in clear picture of the true problem.

(ii) It makes a scientific and mathematical analysis of the problem situations.

(iii) It gives an opportunity to the decision maker to formulate his strategies consistent with the constraints and the objectives.

(iv) It deals with changing situations. Once a plan is arrived through the linear programming it can also be reevaluated for changing conditions.

(v) By using linear programming the decision maker makes sure that he is considering the best solution.

Unit-II

1. What is transportation model?

(i) level of supply at each source and the amount of demand at each destination.

(ii) The unit transportation cost of commodity from each source to each destination.

The objective is to determine the amount to be shift from each source to each destination such that the total transportation cost is minimum.

Note: The transportation model also can be modified to account for multiple commodities.

2. 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.

3. What is an unbalanced transportation problem?

*If the total availability from all origins is not equal to the total demand of all destinations, then it is called unbalanced transportation problem.*The transportation problem is balanced if the total availability is equal to total demand.

*An IBFS can be obtained only for balanced transportation problem.

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6. What is a travelling salesman problem?

There are a no. of cities a salesman must visit. The distance (or time or cost) between every pair of cities is known. He starts from his home city, passes through each city once and only once and returns to his home city. The problem is to find the routes shortest in distance (or time or cost)

7. What is revised simplex method?

The revised simplex method which is a modification of the original method is more economical on the computer, as it computes and stores only the relevant information needed currently for testing and improving the current solution.

8. Define dynamic programming?

Dynamic programming is a mathematical technique of optimization using multistage decision process. That is, the process in which a sequence of interrelated decisions has to be made. It provides a systematic procedure for determining the combination of decisions which maximize overall effectiveness.

9. What is need of dynamic programming?

- (i) all the decisions of a combination are specified
- (ii) the optimal policy can be selected only after all the combinations are evaluated.
- (iii) lot of computational work and too much time is involved.
- (iv) all combinations may not satisfy the limitations and thus may be infeasible.
- (v) the number of combinations is so large.

10. What is Bellman's principle of optimality?

It states that an optimal policy (set of decisions) has the property that whatever be the initial state and initial decisions, the remaining decisions must constitute an optimal policy for the state resulting from the first decision

It implies that given the initial state of a system, an optimal policy for the subsequent stages does not depend upon the policy adopted at the preceding stages.

Note: A problem which does not satisfy the principle of optimality can not be solved by dynamic programming.

11. List the characteristics of dynamic programming problems.

- (i) The problem can be divided into stages, with a policy decision required at each stage.
- (ii) Each stage has a number of states associated with it. The states are various possible conditions in which the system may find itself at that stage of the problem. The number of states may be finite or infinite.
- (iii) The effect of the policy decision at each stage is to transform the current state into a state associated with the next stage.
- (iv) The current situation (state) of the system at a stage is described by a set of variables, called state variables. It is defined to reflect the status of the constraints that bind all stages together.

12. What are the Applications of Dynamic Programming?

(i) In the production area, this technique has been used for production, scheduling and employment smoothening problems.

(ii) It has been used to determine the inventory level and for formulating the inventory recording.

(iii) It can be applied for allocating the scarce resources to different alternative uses such as, allocating the salesmen to different sales districts etc.

(iv) It is used to determine the optional combination of advertising media (TV, Radio, News papers) and the frequency of advertising.

13. Define Decision Tree.

A tree diagram is a graphic construction that represents various activities in a decision problem as if they were branches of a tree may in turn be divided into smaller branches which represent subsequent alternatives.

14. What are the need for Decision Tree Diagram?

It is difficult to describe and confusing to implement when a decision problem involving many branches. Therefore decision maker needs to use the tool, decision tree to portray the logic of the policy. Note that the concept of decision trees provides a systematic approach to many problems that face management.

15. List out the Advantages of Decision Trees.

(i) Decision tree simply sketches the logic structure based on the stated policy. In this respect it is an excellent tool. It is easy to construct, easy to read and easy to update.

(ii) It clearly brings out implicit assumptions and calculations for all to see, question and revise.

(iii) It allows one to understand, simply by inspection, various assumptions and alternative in a graphical form, which is much more easier to understand than the abstract analytical form.

16. List out the Limitations of Decision Trees.

(i) It becomes more and more complicated as number of decision alternatives increases and more variables are introduced.

(ii) It becomes highly complicated when interdependent alternatives and dependent variables are present in the problem.

(iii) It assumes the utility of money is linear.

17. Define Replacement model.

The replacement problem arises because of the following factors

The old item has become worse or requires expensive maintenance

The old item has failed due to accident

A more efficient design of equipment has become available in market

18. Define money value

Since money has a value over time, we often speak: money is worth 10% per year. This can be explained in the following 2 ways.

In one way, spending Rs.100 today would be equivalent to spending Rs.110 in a year's time.

Consequently one rupee after a year from now is equivalent to $(1.1)^{-1}$ rupee today.

19. Define Present worth factor

As we have just seen above, one rupee a year from now is equivalent to $(1.1)^{-1}$ rupee today at the interest rate 10% per year. One rupee spent two years from now is equivalent to $(1.1)^{-2}$ today. Similarly we can say one rupee spent 'n' years from now is equivalent to $(1.1)^{-n}$ today the quantity $(1.1)^{-n}$ is called present worth factor or present value of one rupee spent n years from now.

20. Define Discount rate.

The present worth factor of unit amount to be spent after one year is given by $V=(1+r)^{-1}$. Where r is the interest rate. Then V is called discount rate (technically known as depreciation value).

Unit-III

1. Define inventory?

Inventory may be defined as the stock of goods, commodities or other economic resources that are stored or reserved for smooth and efficient running of business affairs. The inventory may be kept in any one of the following forms.

Raw material inventory

Raw materials which are kept in stock for using in production of goods

Work-in process inventory

Semi-finished goods which are stored during production process.

Finished goods inventory (ie) finished goods awaiting shipments from the factory.

Inventory also include furniture, machinery etc.

2. What are the types of inventory?

(i) Fluctuation inventory

(ii) Anticipated inventories

Lot-size inventory

3. Define fluctuation inventories.

In real-life problems, there are fluctuations in the demand and lead times that affect the production of the items. Such type of safety stock is called fluctuation inventories.

4. Define anticipated inventories.

These are built up in advance for the season of large sales, a promotion programmer or a plant shut down period. Anticipated inventories stores men and machine hours for future participation.

5. Define Lot-size inventories.

Generally rate of consumption is different from rate of production or purchasing. Therefore the items are produced in large quantities, which result in lot-size inventories.

6. List out the reasons for maintaining inventory?

(i) Inventory helps in smooth and efficient running of business

(ii) It provides service to the customers at short notice.

Because of long-uninterrupted runs, production cost is less

It acts as a buffer stock if shop rejections are too many

It takes care of economic fluctuations

7. What is the cost involved in inventory problems?

The following components constitute holding cost.

Interested capital cost: This is the interest charge over the capital invested

Record keeping and administrative costs

Handling cost: These include costs associated with movement of stock, such as cost of labour etc.

Storage costs

Depreciation costs

Taxes and insurance costs

Purchase price or production costs.

8. Define shortage cost (C_2).

The penalty costs that are incurred as a result of running out of stock are known as shortage or stock-out costs. These are denoted by C_2 per unit. In case where the unfilled demand for the goods may

be satisfied at a latter date, these costs are assumed to vary directly with the shortage quantity and the delaying time both. On the other hand if the unfilled demand is lost (no backlog case) shortage costs become proportional to shortage quantity only.

9. Define set-up costs (C₃).

These costs include the fixed cost associated with obtaining goods through placing an order or purchasing or manufacturing or setting up a machinery before starting production. So they include costs of purchase, requisition, follow-up receiving the goods, quality control etc., These are called order costs or replenishment costs, usually denoted by C₃ per production run (cycle). They are assumed to be independent of the quantity ordered or produced.

10. What are the variables in inventory problems?

The variables in inventory model are of two types.

Controlled variables (b) Uncontrolled variables

(a) Controlled variables

(i) How much quantity acquired

(ii) The frequency or timing of acquisition

(iii) The completion stage of stocked items.

Uncontrolled variables

These include holding costs, shortage cost, set up cost and demand.

11. What do mean by lead time?

Elapsed time between the placement of the order and its receipts in inventory is known as lead time.

12. What do mean by reorder level?

This is the time when we should place an order by taking into consideration the interval between placing the order and receiving the supply. For eg., we would like to place a new order precisely at the time when inventory level reaches zero.

13. Define Economic order quantity (E.O.Q)?

Economic order quantity (EOQ) is that size of order which minimize total annual cost of carrying inventory and the cost of ordering under the assumed conditions of certainty and that annual demands are known.

14. Deterministic Inventory models.

(i) purchasing model with no shortages

(ii) Manufacturing model with no shortages

(iii) Purchasing model with shortages

(iv) Manufacturing model with shortages.

15. Define selective control techniques?

Every organization consumes several items of store. Since all the items are not of equal importance, a high degree control on inventories of each item is neither applicable nor useful importance. Such type of classification is named as the principle of selective control.

16. What is mean by FNSD – Analysis based on usage rate of items?

The items can be classified as fast moving items, Normal moving items, slow moving items, dead items (FNSD), we concentrate on F-items and D-item are referred to disposal cell.

17. What are the limitations of ABC – Analysis?

(i) The periodic consumption value (not the unit value) is the basic of for ABC classification can lead to overlooking the needs of spare parts whose criticality is high but consumption value is low.

(ii) If ABC analysis is not updated and reviewed periodically, the real purpose of control may be defeated. For example 'c' items like Diesel etc., may become most high value items in a power crisis.

(iii) ABC analysis does not permit precise consideration of all relevant problems of inventory control. For example a never ending problem in inventory management is that of adequately handling thousands of low value C-items.

18. State game theory.

Business situation involves competition. Effective decision making plays a vital role in such situation mainly because decisions will have direct impact on the revenue earning potentials business organizations.

19. What are the properties for game theory?

- (i) There are finite number of participants called players
- (ii) Each player has a finite number of strategies available to him
- (iii) Every game results in an outcome.

20. Define Uncertainty situation.

When the problems data are subjected to variation and it is not possible to represent them in them in the form of any probability distribution, this situation is called uncertain situation. Game theory is an example of the uncertainty situation.

Unit-IV

1. What is network?

A Network is a symbolic representation of the essential characteristics of a project. Network technique is a tool of project management. PERT and CPM are the widely applied techniques.

2. Define event float in CPM.

The beginning and end points of an activity are called events or nodes. Event is a point in time and does not consume any resources. It is represented by a circle.

3. What is meant by network construction?

The project is split into activities. Start project and finish events of the project are then decided. After deciding the precedence order, the activities are put in a logical sequence by using the graphical notations.

4. What is meant by critical path?

The critical path of a network gives the shortest time in which the whole project can be completed. It is the chain of activities with the longest time duration. Any delay in any of the activities results in the delay of the completion of the project.

5. Define planning?

This involves a listing of tasks or jobs that must be performed to complete a project under consideration. In this phase men, machines and materials required for the project in addition to the estimates of costs and durations of various activities of the project are also determined.

6. Define scheduling?

This phase involves the laying out of the actual activities of the projects in a logical sequence of time in which they have to be performed. Men and material requirements as well as the expected completion time of each activity at each stage of the project are also determined.

7. Define control?

Consists of reviewing the progress of the project whether the actual performance is according to the planned schedule and finding the reasons for difference, if any, between the schedule and

performance. The basic aspect of control is to analyse and correct this difference by taking remedial action wherever possible. PERT and CPM are useful for these functions.

8. List out the rules for network construction?

The following are the primary rules for constructing
 The starting event and ending event of an activity are called tail event and head event, respectively.
 The network should have a unique starting node (tail event)
 The network should have a unique completion node (head event)
 No activity be represented by more than one arc in the network.

9. What are the general guidelines for network crashing?

- (i) Duration of each activity
- (ii) Early and late events times for each node
- (iii) Free float for each activity

10. Define resource allocation technique?

The objective of resource allocation technique is to adjust the non-critical activities such that the resource requirement in each period is within the constraint on the resource availability. In this process, the project completion time may be extended to satisfy the limit on the resource availability.

11. Define players?

There are two players in a game. The players may be any two companies (for example company A and company B competing for tenders, two countries planning for trade gains in a third country two persons bidding in a game, etc.

12. Define strategy?

It is a course of action taken by a player, for example, giving computer furniture's free of cost, giving 20% additional hardware, giving special price, etc. while selling computer hardware.

13. Define pure strategy?

If a player selects a particular strategy with a probability of 1, then that strategy is known as a pure strategy. This means that the player is selecting that particular strategy alone ignoring his remaining strategies.

14. Define mixed strategy?

If a player follows more than one strategy, then the player is said to following a mixed strategy. But the probability of selection of the individual strategies will be less than one and their sum will be equal to one. If player B follows a mixed strategy, then a sample set of probabilities of selection of mixed strategy

$$q_1=0.65, q_2=1, q_3=0.35$$

It is clear that the sum of the probabilities is equal to 1. That is

$$q_1+q_2+q_3= 0.65+0+0.35 =1$$

15. Define maximin principle?

This principle maximizes the minimum guaranteed gains of player A. The minimum gains with respect to different alternatives of A, irrespective of B's alternative are obtained first. The maximum of these minimum gains is known as the maximin value and the corresponding alternative is called as maximin strategy.

16. Define minimax principle?

This principle minimizes the maximum losses. The maximum losses with respect to different alternative of player B, irrespective of player A's alternative are obtained first. The minimum of these

maximum losses is known as the minimax value and the corresponding alternative is called as minimax strategy.

17. What is saddle point?

In a game, if the maximin value is equal to the minimax value, then the game is said to have a saddle point. The intersecting cell corresponding to these values is known as the saddle point. If the game has a saddle point, then each player has a pure strategy.

18. What is mean by value of the game?

If the game has a saddle point, then the value of the cell at the saddle point is called the value of the game, otherwise, the value of the game is computed based on expected value calculations which will be explained latter.

19. What is mean by two-person zero-sum game?

In a game with two players, if the gain of one player is equal to the loss of another player, then that game is called two-person zero-sum game.

20. What is the crashing of project network?

In any project network, the first stage is to determine critical path with normal activity timings. Then, the execution of various activities can be expedited, if necessary. This is called crashing of activity timings.

Unit-V

1. Define Queuing Models.

In every day life it is seen that a number of people arrive at a cinema ticket window. If the people arrive too frequently they will have to wait for getting tickets or sometimes do without it. Under such circumstances the only alternative is to form a Queue called the waiting line in order to maintain a proper discipline. Here the arriving people are called customers and the persons issuing the tickets is called a server.

2. What are different types of Queuing system?

A Queuing system can be completely described by

- (i) the input (or arrival pattern)
- (ii) the service mechanism (or service pattern)
- (iii) the Queue discipline
- (iv) Customer's behavior

3. Define Bulk arrival.

Generally, it is assumed that the customers arrive into the system one by one. But, in some reality, customers may arrive in groups. Such arrival is called as bulk arrival.

4. Define Jockeying.

If there is more than one queue, the customers from one queue will be tempted to join another queue because of its smaller size. This behavior of the customers is known as queue jockeying.

5. Define Balking.

If the queue length appears very large to a customer he/she may not join the queue. This property is known as balking of customers.

6. Define Reneging.

Sometimes, a customer who is already in the queue will leave the queue will leave the queue in anticipation of longer waiting time. This kind of departure from the queue without receiving the service is known as reneging.

7. what is the Terminologies of Queuing system.

(i) The number of queues may be more than one. If there is a queue for male as well as for female customers, then generally, alternate mode of selecting customers from each queue is followed.

(ii) The number of servers may be more than one. This is an example of parallel counters for providing service.

(iii) Sometimes, the service may be provided in multistage in sequential order. This type of system is known as queues in tandem.

8. Define Poisson Arrival Process?

A commonly used model for random, mutually independent message arrivals is the Poisson process. The Poisson distribution can be obtained by evaluating the following assumptions for arrivals during an infinitesimal short period of time Δt

The probability that one arrival occurs between t and $t + \Delta t$ is $\lambda \Delta t + o(\Delta t)$, where λ is a constant, independent of the time t , and independent of arrivals in earlier intervals. λ is called the arrival rate.

The number of arrivals in non-overlapping intervals are statistically independent.

The probability of two or more arrivals happening during Δt is negligible compared to the probability of zero or one arrival, i.e., it is of the order $o(\Delta t)$.

Combining the first and third assumption, the probability of no arrivals during the interval $t, t + \Delta t$ is found to be $1 - \lambda \Delta t + o(\Delta t)$

9. Define dual simplex method?

The dual simplex method is used to solve problems which start dual feasible i.e., whose primal is optimal but infeasible. In this method the solution starts optimum but infeasible and remains infeasible until the true optimum is reached at which the solution becomes feasible.

10. What is the formulation of dual problems?

There are two important forms of primal – dual pairs, namely symmetric form and unsymmetric form.

11. List out any two important result in duality?

(i) If one is a maximization problem then the other is a minimization problem.

(ii) If dual has no feasible solution, then primal also admits no feasible solution.

12. Define proportionality?

The contribution of each variable in the objective function or its usage of the resources is directly proportional to the value of the variable. i.e., if resource availability increases by some percentage, then the output shall also increase by the same percentage.

13. Define divisibility?

The variables are not restricted to integer values.

14. Define Certainty or deterministic?

Co-efficient in the objective function and constraints are completely known and do not change during the period under study in all the problems considered.

15. Define finiteness?

Variables and constraints are finite in number.

16. Define Optimality?

In a linear programming problems we determine the decision variables so as to extremise (optimize) the objective function of the LLP.

17. Define descriptive model?

One which just describes a situation or system

18. Define Predictive model?

One which predicts something based on some data. Predicting election results before actually the counting is completed.

19. Define Prescriptive model?

Which prescribes or suggests a course of action for a problem.

20. Define Analytic model?

Which exact solution is obtained by mathematical methods in closed form

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