Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any
equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q1. A) Attempt any Three of the following. **(3x4=12 Mark)**

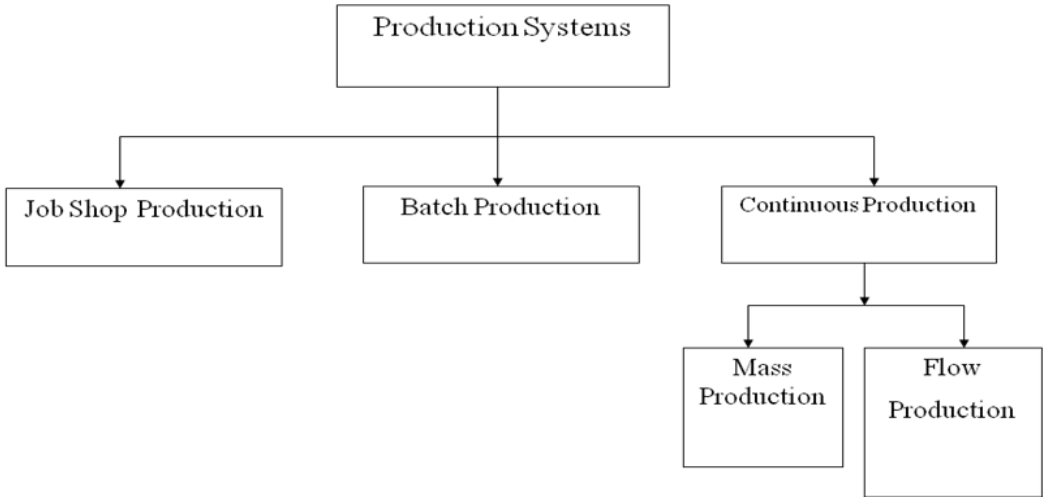
(i) Define production. List types of production system.

Answer:-

Production: -

- Production is an organized activity of transforming raw materials into a finished product.
- Production is any process or procedure developed to transform a set of input elements like men, materials, capital, information and energy into a specified set of output elements like finished products and services in proper quantity and quality, thus achieving the objectives of an organization/enterprise.
- It is defined as the step by step conversion of one form of material in to another form through chemical or mechanical process to create the utility of the product to the end user.

[2 Marks]



[2 Marks]

(ii) Define fixed cost and variable cost. Give two examples of each.

Answer:-

1) **Fixed Cost:-**These are those indirect expenses, which remain constant irrespective of volume of production.

   Examples: - Salaries of office staff, depreciation of machine, equipment and building cost, insurance on equipments and interests on capital invested.

   (1 Mark for definition and1 mark for any two correct examples)

2) **Variable cost**: - These are those indirect expenses which vary with the volume of production. Variable cost increases proportionately with the rate of production but fixed cost is always constant.
   Examples: - Variable cost includes power or fuel charges, repair and maintenance of machine tool, raw material cost, and expenses on tools.
   (1 Mark for definition and1 mark for any two correct examples)

c) Differentiate between floor inspection and centralized inspection.
Answer:-

Sr. no.	**Floor Inspection**	**Centralized Inspection**
1	Inspection is done at the place where the part is made.	Inspection is done at a centralized place.
2	Generally small instruments are used.	Sensitive and delicate instruments are used.
3	For inspection of heavy parts floor inspection is used.	Light weight parts can be chosen for centralized inspection.
4	Online inspection is possible	Offline inspection is need to be done
5	No movement of work piece.	Work piece needs to be assembled and move to the inspection station.
6	No waiting time required for inspection.	Requires waiting point for inspection.

7	Even the machine operator can do inspection of the parts.	Expertise required for this type of inspection.

[1 mark each for any 4 correct points]

D) State the factors affecting scheduling.

Answer:-

Internal Factors:-

1) Stock of finished goods
2) Availability of manpower.
3) Availability of machines.
4) Availability of material.
5) Availabilities of supportive Manufacturing facilities.
6) Work In Progress.

[1/2 Mark each for any 4 correct points]

External Factors:-

1) Customers Demand
2) Customers delivery dates
3) Stock of good already lying with dealers and retailers
4) Rules and regulation of local authorities
5) Inability of vendor to fulfill the commitment

[1/2 Mark each for any 4 correct points]

b) Attempt any ONE of the following.

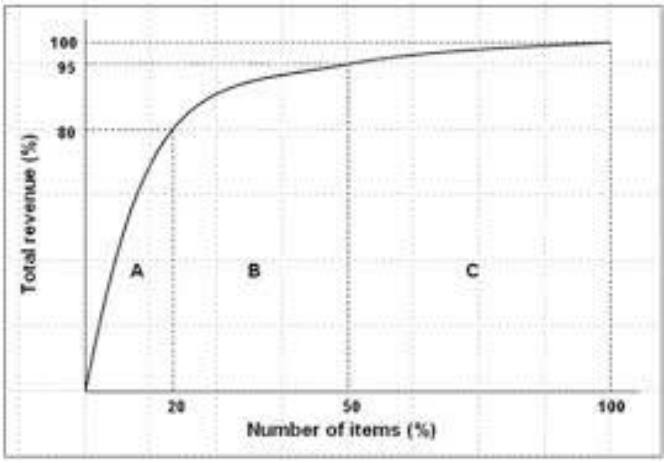
(i) Explain in brief ABC analysis and its role in inventory control

Answer:-

ABC Analysis:-

It is a technique which is used to classify the items in store into A, B and C class items based on demand of the stock. If the stock on hand of a particular items becomes less than or equal to its reorder level immediately an order is placed for its economical quantity.

1) A: -Items are high valued items but are limited or few in numbers. They need careful and close inventory control.
2) B: -Items are medium valued items and their number lies between A and C. Such items need moderate control. They are more important than C-Items and also required careful storages and handing.
3) C: -Items are low valued but maximum number of items. These items do not need in any control rather controlling them is uneconomical. They are generally produced just before they finish.**[3 Mark]**



[1 Mark]

Role of ABC analysis in inventory control:-

1) It helps in segregating the items from one another
2) It tells how much valued the item is
3) It indicates controlling the item to what extent in the interest of organization
4) ABC analysis simplifies the controlling the inventory level as focusing on specific item can be possible
5) It reduces the cost of maintaining the records for number of items.

[2 Marks]

b) Define routing. Distinguish between routing and scheduling.

Answer:-

Routine:-

Routing can be defined as the determination of path and sequence of operations to be performed on the job from one machine to another taking from the raw material to the finished products. It determines what work is to be done , where it is to be done and how it will be done. **[2 Mark]**

Sr No.	Routing	Scheduling
1	It requires technical staff for its implementation.	Non technical staff can perform it.
2	It shows most optimum path to be followed.	It is the assignment of work with the time specification.
3	It does not consider time spend on each station	It considers the time required at each station
4	It shows sequence to be followed	It does not considers the sequence to be followed
5	It is unaffected by external factors	External factors affect it

[1 mark for any four correct points]

Q2. Attempt any Two of the following.

a) Explain process layout with schematic diagram and state its advantages and disadvantages.

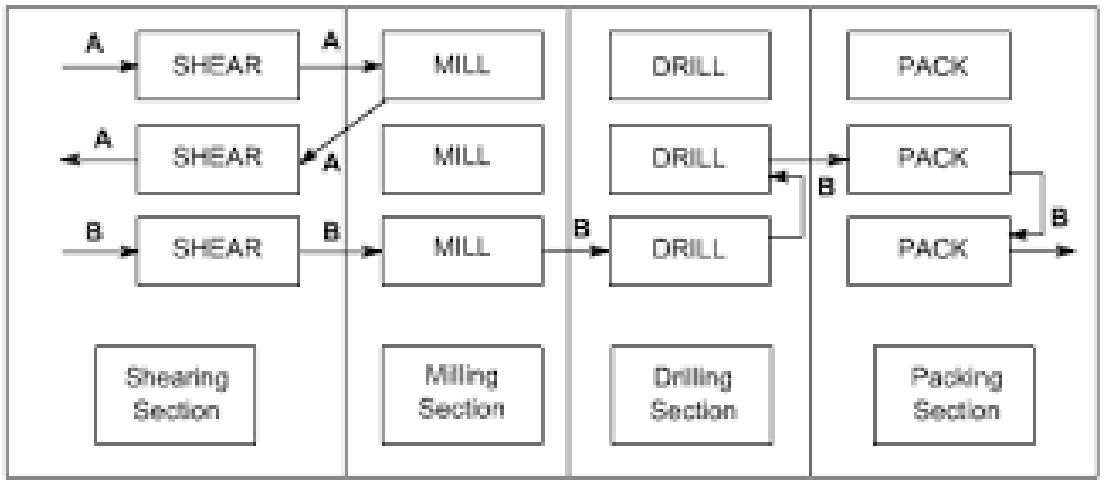
Answer:-

Process Layout:-

It is also known as functional layout and is characterized by keeping similar machines or operations at one location. This type of layout is generally employed for industries engaged in job order production.

Example: - All lathes will be at one place, all milling machines will be at one place etc.

[2 Marks]



[2 Marks]

Advantages:-

1) Wide flexibility exists
2) Better utilization of equipment
3) Less number of machines are required
4) Better product quality
5) Varieties of products can be manufactured

[1/2 Mark for any 4 correct points]

Disadvantages:-

1) Needs more space
2) Automatic material handling is extremely difficult
3) Increased Work in progress inventory
4) Production control is difficult
5) It is difficult to implement and maintain.

[1/2 Mark for any 4 correct points]

b) Explain functions of the stores. Explain one bin and two bin system.

Answer:-

Functions of stores:-

1)To receive material, goods after checking them for identification.

2) To receive parts and components which have been processed in the inventory.

3) To see that the stock of items at any time should not fall below the minimum defined level or should not go in excess of fixed maximum quantity.

4) To provide arrangement for systematic and efficient storing of materials.

5) To maintain stocks safely and in good condition by taking all precaution to ensure that they do not damaged.

6) To maintain accurate and prompt distribution of items to department on the demand of authorized stores requisition.

7) To maintain records of quantity moved and quantity in stock.

8) To secure the store items from theft, wastage.

9) To maintain cleaned and healthy environment in store.

[1/2 Mark for any 8 correct points]

One bin system:- One-bin inventory system is a simple inventory control system which depends on replenishing supply at fixed time intervals and not at a minimum stock level or a Kanban signal. The one bin inventory system is useful when demand is predictable, stable, and the process does not require a substantial amount of Safety stock.
Eg. **Supply of Sand to a concrete plant.**

[2 Marks for correct explanation]

Two bin system:-

One of the oldest systems of inventory control is the two- bin system. In the two bin system, stock of each item is separated into two bins. One bin contains stock; just enough to last from the date of new order is placed until it is received in inventory. The other bin contains a quantity of stock, enough to satisfy probable demand during the period of replenishment. To start with, the stock is issued from first bin. When the first bin is empty, an order for replenishment is placed, and the stock in the second bin is utilized until the ordered material is received.
One bin: - Stock
Second bin: - Lead time stock

[2 Marks for correct explanation]

c) If worker takes 15 minutes as a standard time for a job in which total allowance is 20% of normal time. If the rating of the worker is 100% find the actual time required by the worker.

Given Data:

Standard Time (ST) = 15 Minutes

Rating Factor (RF) = 100 %

Allowance = 20 % of Normal Time (NT)

Standard Time (ST) = Normal Time (NT) + Allowance

15 = NT + (20/100) NT

15 = NT + (1 + 0.2)

NT = 15/1.2

NT = 12.5 Minutes = Basic Time (BT)

We Know That,

Basic Time = (Observed (Actual) Time x Rating Factor)/ 100

12.5 = (Observed (Actual) Time x 100)/ 100

12.5 = Observed (Actual) Time

Actual (Observed) Time (AT) required by the worker to complete the job is **12.5 Minutes.**

(4 Marks for Calculation of NT (BT), 4 Marks for Calculation of Actual Time)

Q3. Attempt any four of the following. (4x4 = 16 Marks)

a) Explain the role of government and employer for productivity improvement.

Answer:-

Role of government and employer:-

While setting the target for production one always aim to keep it at minimum cost and max. output. Government provides infrastructure which is suitable for industries and helping ultimately to the improvement in productivity. Employer should try to provide all kinds of facilities to the employees to keep them morally awakened regarding their work and enhance their efficiency.
Government policies make considerable effect on productivity improvement. Related explanations are desirable.

b) What are the objectives of plant layout?

Answer:-

1) Minimize the material handling
2) Space utilization
3) Increase the flexibility
4) To increase the productivity
5) To reduce bottlenecks
6) To design suitable and proper workstation
7) Unidirectional material flow
8) To provide better working conditions

[1/2 mark for each point]

c) Describe the 3-2-1 principle of location

Answer:- 3-2-1 Principle of Location used in Jig & Fixtures:

[1] It is also known as six pin or six point location principle. In this, the three adjacent locating surfaces of the blank (work piece) are resting against 3, 2 and 1 pins respectively, which prevent 9 degrees of freedom.

[2] The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping.

The **3-2-1 principle** states that the six locators are sufficient to restrict the required degree of freedom of any work piece. In this, motion is restricted using clamps and locators. A three pin base can restrict five motions and six pins restrict nine motions.

Methodology of 3-2-1 Principle: For this, refer the below figure;

[1] The work piece is resting on three pins A, B and C which are inserted in the base of the fixed body.

[2] The work piece cannot rotate about the axes XX and YY and also cannot move downward.

[3] In this way, the **five degrees of freedom** 1,2,3,4 and 5 have been arrested.

[4] Two pins D and E are inserted in the fixed body, in a plane perpendicular to the plane containing pins A, B & C.

[5] Now the work piece cannot rotate about the Z axis and also it cannot move towards the left.

[6] Hence the addition of pins D and E restrict three more degrees of freedom, namely 6, 7 and 8.

[7] Another pin F in the second vertical face of the fixed body, arrests **degree of freedom 9**.

The above method of locating a work piece in a fixture is called the **3-2-1 Principle**.

(4 Marks for Methodology with proper explanation of 3-2-1 principle)

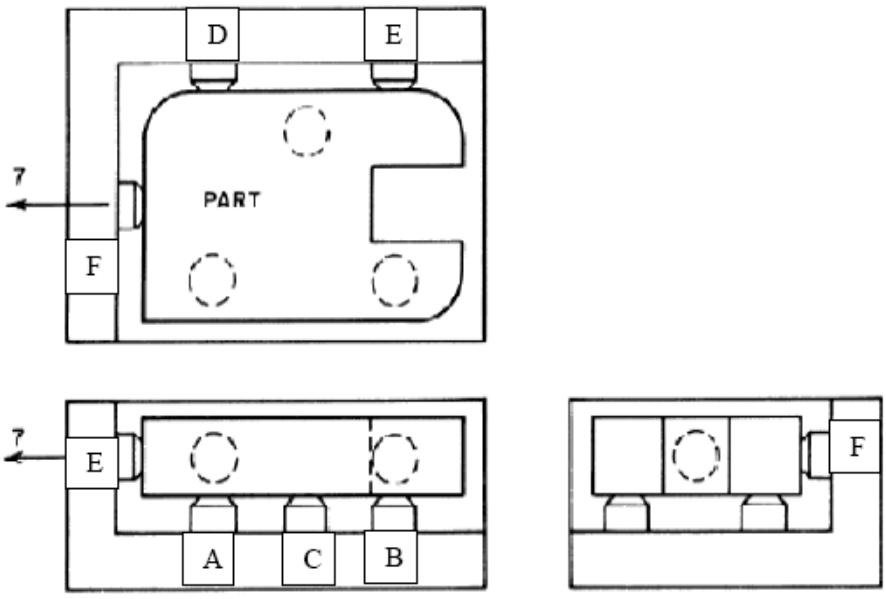


Figure: Example of 3-2-1 Principle with work piece located in a fixed body

d) State the importance of determination of inspection stages in process planning.

Answer:-

Importance of Inspection stages:-

1) It decides the value of product
2) It helps to improve quality of product
3) It decides cost of inspection
4) It decides manufacturing cycle time of a product
5) Type of layout need to be selected for proper inspection stages

6) It is necessary to separate defective and non defective part at early stage
7) To fix the sources of defects determination of proper inspection stage is necessary.

[1 Mark for any 4 correct points]

e) Explain the concept of 'Just in time' manufacturing as a tool of improving the productivity.

Answer:-

JIT:-

Just in time refers to the producing the part/component only when it is required. According to Just in time approach material is made available when it is demanded for further activities. Just in Time assures right material, at right place, at right time, at right cost, at right quantity. **[1 mark]**

The main objectives of JIT are:-

- To reduce inventory level
- To eliminate unwanted costs associated with inventory
- To satisfy customer requirement
- To ensure production flow
- To optimize lead time **[2 marks]**

8.1.2 Just in time assures

- Right material
- At right place
- At right cost
- At right time
- At right quantity

[1 Mark]

Q. 4 a) Attempt any Three of the following

i) Name the material handling devices suitable for process layout and explain any one.

Ans-

1. Trucks**(2 Marks)**
    a. Power lift
        i. Fork lift truck
        ii. Elevating platform truck
    b. Hand lift truck
    c. Porter's trolley
2. Tractors and trailers
3. Hoist and cranes
4. Conveyor

Explanation of above any one – (2 Marks)

Trucks:

- Manually operated trucks are most commonly used for movement of material over short distance where the loads are not heavy.
- Most commonly used trucks are fork lift truck.
- Heavy duty machines having diesel or petrol engine with large wheel are used for stockyard work.
- Trucks with smaller wheels are used for both operations inside & outside.

ii) Define plant capacity, machine capacity and plant capacity

Ans-

Plant Capacity: Plant capacity is the amount of finished product or final product produced per hour. **(1Mark)**

Machine capacity: It is defined as the number of pieces that can be produced through one machine for a given period of time.**(1 Mark)**

Plant efficiency: It is the ratio of actual o/p of the plant in terms of standard machine hours to total available machine hours.

It can also be defined as the ratio of actual o/p of the plant in terms of standard man hours to total available man hours.**(2 Mark)**

iii) What are the different factor affecting process planning? (Any Four points)

1. The size and shape of the part.
2. Strength characteristic of the part.
3. Unavailability of man, machine, and material at right time affects process planning.
4. The accuracy and surface quality required.
5. Insufficient input to the designer at earlier stage causes rework in process planning.
6. Frequent change in design causes change in process planning.

iv) Explain the concept of line balancing. (2 Marks)

Line balancing:

Objective of line balancing is to distribute tasks evenly over the workstations so that idle time of man & machine is minimized.

Tasks are grouped so that their total time is preferably equal to or a little lesser than the time available at each workstation. This reduces the idle time.

Ex. Suppose there are three machines A, B, C which can process, 10 & 15 pieces per unit time & pieces flow from A to B to c.

Since A has min. capacity, B remains idle for 50% of its time & C for 66.66% of its time. It shows line is unbalanced.

One way to balance the line is to have 3 machines of A, 2 of B & 1 of C.

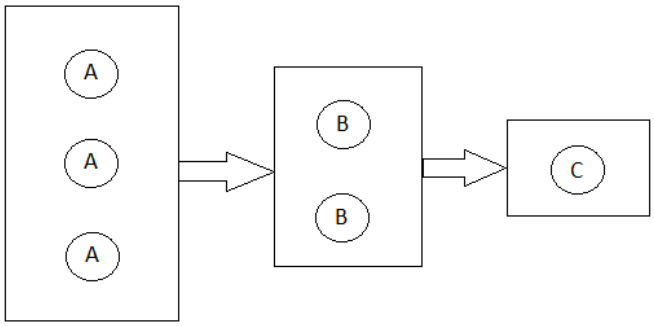


Fig. Line Balancing

b) Attempt any ONE of the following.

i) Enlist the types of assembly. What are the techniques of assembly planning?Assembly:

The joining of the sub components of complete part is termed as the assembly. Assembly includes the joining of the two or more parts sequentially in order to make the whole component.

Types of Assembly Planning:-

1) Unit assembly/ fixed assembly/ stationary assembly
2) Progressive assembly **(2 Marks)**

1) Unit assembly/ fixed assembly/ stationary assembly :- (2 Marks)

In unit assembly the complete joining of two or more part is carried out at a single place. The complete product is assembled at a single assembly work station. It follows fixed position layout for ex: CNC machines, nuclear reactor.

2) Progressive assembly: - In progressive assembly the components moves along the assembly line and at each work station few components are joined to the parts or sub assembly. It uses line type layout where assembly starts at one end & final product is obtained at other end i.e. assembly is being done on the production line itself in conjunction with operation. Ex: Automobile assembly, T.V units**(2 Marks)**

ii) Enlist the types of material handling devices and explain any one in brief.

1. Trucks**(3 Marks)**
    a. Power lift
        i. Fork lift truck
        ii. Elevating platform truck
    b. Hand lift truck

c. Porter's trolley

2. Tractors and trailers
3. Hoist and cranes
4. Conveyor

Explanation of above any one – (3 Marks)

Tractor and Trailers:

When there is a flow of material between storage point and rail, road cars, motor, truck, or a point in a manufacturing plant having distance between 30 to 70 meters or more tractors and trailers are economical than forklift. Tractor is like railway engine. A trailer with properly designed automatic coupler can be quickly and automatically coupled to a tractor, pulled a short distance backed, spotted in position and disengaged without the tractor driver leaving his seat.

Q. 5 Attempt any Four of the following

a) Explain the concept and need of rapid prototyping.

Rapid prototyping can be defined to automatic construction of physical object from computer aided design (CAD). Rapid prototyping also referred to as solid free-form manufacturing, computer automated manufacturing and layered manufacturing.

The process of rapid prototyping starts with taking virtual design from computer-aided design. This virtual design is transferred into thin, virtual, horizontal cross section. Each cross section creates physical space one by one and in this way model is finished. By using additive fabrication, the data of CAD drawing is transformed into successive layers of liquid, powder or sheet material and the model is completed from series of cross section. The virtual cross section are joined together or fused automatically to create final shape. Then STL file format is used as the standard data interface between CAD software and the machine.**(2Marks)**

NEEDS:

1. To decrease the development time.
2. To decrease costly mistake.
3. To increase effective communication.
4. It helps in shortening of product life cycle.
5. To extend product life cycle by adding necessary feature.
6. Eliminating redundant feature early in the design.**(2 Marks)**

b) Describe flow process chart in brief.

- Flow process chart present more detail picture describing the activities associated with material, men or machine and which records the sequence of operation, transportation, inspection and delays that occur.
- There are mainly three types of flow process charts:

Man type- which records what the worker does.
Material type- which records how material is handled
Equipment type- which record how the equipment is used

- **Steps followed in preparing a flow process chart:**
  1. Select the object.
  2. Choose the subject.
  3. Select the beginning and end point.
  4. Write brief description of each element in chronological order
  5. Apply symbols. Enter distance travelled or time taken.
  6. Enter the number, color code etc.
  7. Summaries the chart.

- The flow process chart consists of three parts- heading, body and summary.
- **Heading** includes type of chart, object, location, method, date etc.
- **Body** of chart including symbols, brief description of element, distance moved and time taken.
- **Summary** includes number of operation storages, delays, inspection and also includes total time required for the job and total distance travelled.**(4 Marks)**

c) Explain the role of ergonomics in production system.

- **Ergonomics** deals with application of laws governing man-machine system to the analysis and design of machines to enhance human (operator) efficiency.
- If you are an employer or an employee in the manufacturing, construction, maritime, and agricultural industries and you or your employees' work activities and job conditions which include Repeating the same motion throughout your workday, Working in awkward or stationary positions, Lifting heavy or awkward items, using excessive force to perform tasks, and being exposed to excessive vibration or extreme temperatures. It means that if the design of any machine a thought is given to ergonomics, it surely improves efficiency of human being.
- An ergonomic workstation facilitates work and maintains good employee health. The result of this, increased motivation and satisfaction, higher performance, efficiency, and processing quality, as well as fewer absences due to illness.
- Improved efficiency is an important tool regarded for improved productivity. Hence, Work study & Ergonomics are means for higher productivity.
  (4 Marks)

d) Differentiate between jig and fixtures.

(Any Four points)

SR. NO.	JIG	FIXTURE
1	A jig is a device which not only holds and supports the work piece but it also locates and guides the tool.	A fixture is work holding device which only holds and supports the work piece but does not guide the tool.

2	In jigs, drill bushes are used to locate the tool.	In fixture setting blocks, feeler gauges are used to locate the tool.
3	A jig is lighter in construction	Fixture is heavier in construction.
4	It is usually not fixed to the machine table.	It is usually fixed to the machine table.
5	Most jigs use standard parts such as drill bushes,dwel pins etc.	Fixture does not use standard components.
6	It is used in drilling, reaming or tapping operation.	It is used for operation like milling,planning,shaping,turning etc.

e) State the necessity of material requirement planning.

i. To maintain the least inventory required to adequately meet the job requirements
ii. To guarantee the finished products can be produced and delivered in a timely manner
iii. To efficiently purchasing of new stock, plan the daily manufacturing, and deliver finished products to flow without interruption or incident
iv. It focuses on having all components available at right place in right quantity at right time.

(One mark for each point)

f) How 5 'S' can be used as waste management technique?

Seiri is the first step of the 5S method. It means "to sort" or organize.
Seiri has two main goals:
1.Remove unnecessary objects 2.Reduce waste

What does it means to "reduce waste" to us. This goes beyond simply "reducing waste material" by identifying all hindrances and generating ideas for improvements. Are work instructions available, accurate, and used Work instructions can help improve quality, reduce reject rates and increase productivity.

What safety hazards exist? Cluttered floors; missing safety guards on machinery; electrical faults; broken steps on ladders.
1.Are materials being waster?
2.Will employees become ill?
3.Do we have the right tools, in the right places, in good condition?
Waste reduction techniques should be key components of any cost-effective, comprehensive waste management program. They do not have to be based on complex technology or require large capital expenditures. **(4 marks)**

Q. 6 Attempt any Four of the following

a) Enlist the general principles of jig and fixture design.

1. The jig and fixture should be as open as possible to minimize chip or burr accumulation and to enable the operator to remove the chips easily with a brush or an air jet.
2. Fool Proofing
3. Clearance
4. Rigidity
5. Trunnions
6. Burr grooves

7. Ejectors
8. Inserts
9. Design for safety
10. Sighting surfaces
11. Simplicity in Design
12. Economical **(eight points 1 mark each)**

b)Explain DMIAC cycle in brief.

DMAIC is a data-driven quality strategy used to improve processes. It is an integral part of a Six Sigma initiative. The model is known as Define-Measure---Analysis---Improve---Control. DMAIC can be elaborated as follows:

Define- The goal of improvement activity. The goal can be different at different levels. At the project level, goal can be to reduce the defect level. At the operation level, the goal can be to increase output of production department. At organization level, goal can be greater customer loyalty, increased market share or increased employee satisfaction.

Measure- The existing system, valid and reliable measuring system helps to monitor progress in achieving the goal.

Analyze- The system to reduced gap between existing system and desired goal. Statistical tool can be used in the analysis. Analysis is helps to determine the resources are needed for particular task and also determine the root cause to any failure.

Improve- Better and cheaper ways of doing the things should be search. In this project management and other management tool are very useful. And statistical methods can be used to validate the improvement.

Control- In this standardization such as ISO9000 can help for documentation. During the project how one can control the risk, quality, cost, schedule, scope and changes to plan? Proper controls are made to maintain the higher output.**(4 marks)**

c) Describe procedure of conducting time study. (4 Marks)

The various steps involved in time study procedure are as follows:

1. Select the task to be timed.
2. Standardized the method of working.
3. Select the operator to be studied.
4. Record necessary details of job and condition of work.
5. Break the task into elements.
6. Measure the duration of each element and check the pace of working.
7. Extend the observed time into normal/ basic time.
8. Calculate the standard time after adding the various allowances with normal time.

d) Define 'EOQ' briefly. Explain 'EOQ' model.

The ordering quantity (Q) for which cost is minimum is called EOQ. In case of purchasing it is called as EOQ. In case of production of an item within an organization, it is called Economic Batch quantity. It is could be used effectively for the items that are grouped together.**(2 marks)**

EOQ MODEL- (2 marks)

The function of EOQ model is to determine the optimal order size that minimizes total inventory cost.Fig. shows relationship between inventory and cost. Inventory quantity (ordering) is represented on X axis and cost on Y axis. Ordering cost curve shows that ordering cost reduces with increase in ordering quantity. Carrying cost is directly proportional to number of items. The total cost is the sum of ordering cost and carrying cost. Total cost initially reduces, reaches minimum and then increases.

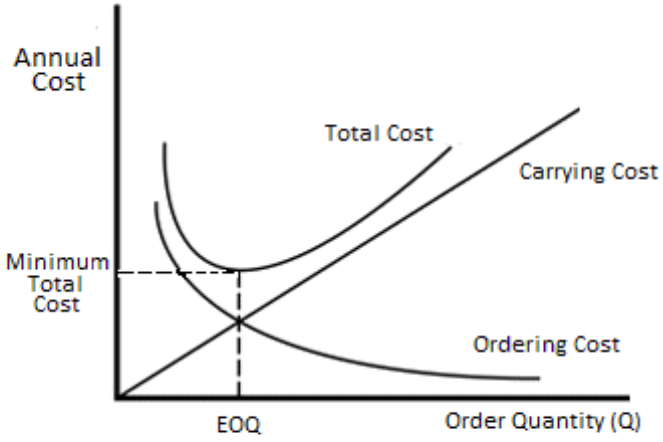


Fig. Inventory Cost Curve

The total inventory cost is the sum of ordering cost and carrying cost:

$$TC = \frac{CoD}{Q} + \frac{CcQ}{2}$$

Where,

TC – Total inventory cost (Rs.)

Co – Ordering cost per order.

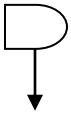
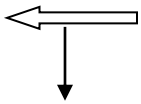
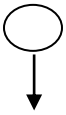
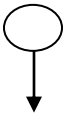
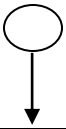
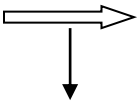
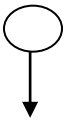
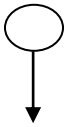
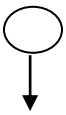
Cc – Cost of carrying one unit inventory.

D – Demand rate, units per time.

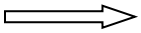
Q – Order quantity.

e) Describe the two handed process chart changing refill in ball pen.

- Task :- Changing refill in ball pen
- Chart begins :- Both hands free before task
- Chart ends :- Both hands free after task
- Charted by :- -----
- Date of Charting :- ------ **(3 marks)**

Description	Left hand	Right hand	Description
Delay (Idle)			Ball pen to the work station
Hold the pen securely			Disassemble the body
Remove the old refill			Hold the body
Take new refill to workstation			Hold the body
Position the refill in body			Hold the body
Tightened the assembly			Hold the body securely
Keep the assembly in bin			Delay (Idle)

Summary**(1mark)**

Symbol				
Frequency (LH)	5	1	1	0
Frequency (RH)	2	1	1	3