MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

WINTER– 14 EXAMINATION

Subject Code: **12243** **Model Answer**

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.

Q 1 a) Attempt any three

i) What are the different types of production system? Explain any one of them.

(Types 02 Marks + any one type explanation 02 marks)

Ans:--The production system is a part of large Business firm, which can be viewed as a framework within which the creation of value can occur. At one end of the production system are the inputs and other end are outputs. The production of any components or service can be viewed in form of production system where inputs are converted into output.

Fowling are the different production systems

a) Job order production system
b) Batch production system
c) Mass production system
d) Process production system

Job Order Production system

Equipment---------- Standard machinery depending up on the light, Medium, Heavy Engineering
Layout of factory------ Small machines will be arranged in groups ie. Functional layout
Type of flow---------- Intermittent Flow
Cost & Time ---------- Will be in relation with the turn over
Material handling------ Depends on light, Medium, on Heavy Engineering.
Foremen ---------- Ratio of supervisor to operators is 1:30

Design ---------- As per customer's requirements

Type of industry --------- Ship building, Civil Engineering, Casting etc.

ii) What are the symptoms of bad plant layout?

(Any 8 points ½ mark each)

Symptoms of Bad Layout are as follows

1) Some machines are heavily loaded and some are idle for long periods.
2) Long production cycles.
3) Bottlenecks in production
4) Stock control difficulties.
5) Poor house keeping
6) Idle workers & equipments.
7) Obstacles in material flow.
8) Backtracking
9) Delays in delivery
10) Excessive handling

iii) Explain the effect of the following factors on process planning.

(Explanation in brief 04 marks)

1 Tolerance and surface finish

2 Choice of layout

Ans. :--- Planning of production operations should ensure that these proceed under controlled conditions in the specified manner and sequences. Controlled conditions include appropriate controls for materials, production, equipments, processes and procedures. The effect of tolerance and surface finish & choice of layout on process planning is Degree to which the product is simplified or standardized i.e. Specified surface finish & Tolerance, tolerance decides the type of fit & surface finish in micron decides the capacity of machine again which is directly related with cost of production similarly choice of plant layout, if group type selected which reduces waiting but also reduce machine utilization. Choice of lay out also depends on degree to which operations and process are simplified, determination of alternate machines to achieve flexibility.etc.

iv) Define the following terms

1) **Scheduling**
2) **Routing**

1) **Scheduling** **(02 marks)**

Scheduling determines the program me for the operation. In scheduling , order of sequence of each operation and their starting and finishing time is decided so the required materials ,machine etc. may be kept ready as per schedule i.e. Fixation of time and date for each operation. The planning department assigns the timing for various operations or processes. There are two types of schedules. Master schedule & Manufacturing schedule.

2) **Routing** **(02 marks)**

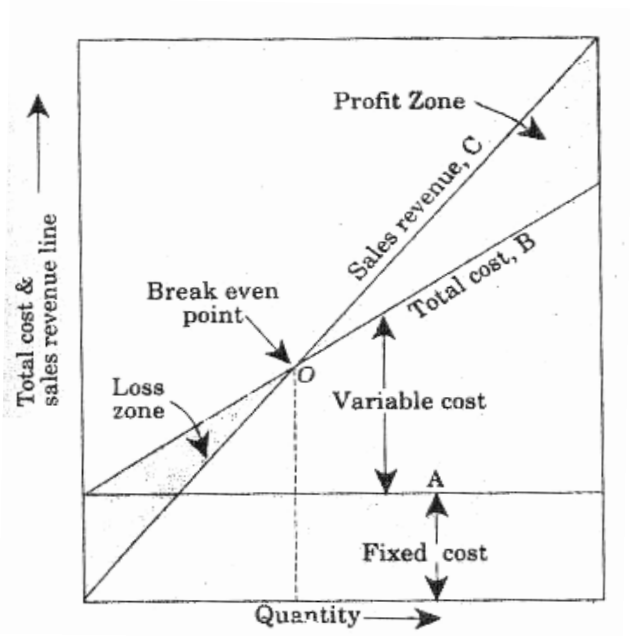
Routing may be defend as the selection of path which each part of the product will follow while being transferred from raw material to finished products .Path of the product will also give sequence of operation to be performed while being manufactured. Routing determines the best and cheapest sequence of operation and to see that this sequence is rigidly followed.

Q 1 b) Attempt any ONE of the following

i) Explain the concept of 'break even analysis'

(for figure 02 marks, explanation 02 marks)

Ans:-



By using breaking chart these chart manager can predict probable profits at various levels of output.

Line A Represents fixed costs

Line B Represents total costs

Line C Represents sales revenue

The point where line B&C Intersect each other is breakeven point .The space between line B&C to right of the breakeven point represents potential profit ,where as to the left of the even point potential loss. The amount of loss and profit can be measured on vertical scale. This breakeven point is also known as cut even point. Breakeven point me be determent in terms of physical units or in money terms.

Q 1 b ii)Explain progress control and what are the steps involved in progress control ?

(For explanation 01 mark, for steps 03 marks)

Ans:-**Progress control**

After dispatching production orders various shops , its necessary to regulate the progress of the job through various processes for this purpose, a follow up section is formed. follow up section reports daily progress reports and compeers with planed pre schedule and boost it. Steps involved in progress control.

Step 1 Procurement of material

i)Procurement of material in required time to start production as per schedule.

Step 2 In process updating

ii) In process updating during the operations of transforming from raw material to final shape as per schedule.

Step 3 Inventory control

iii) follow -up section ensure that all the parts should remain ready for assembling urpose in actual quantities at required time.

Step 4 control causes of delays.

iv) follow -up section should check the main causes which are generally responsible for delays.

Q 2. Attempt any TWO of the following.

a) Explain fixed plant layout with suitable example .Also give advantages and disadvantages.

(For explanation 03 mark, example 01 marks, for Advantage 02 marks & Disadvantage 02 marks)

Ans :-This type of layout is used in manufacturing huge aircrafts ,ship vessels, pressure vessels etc. where the products are too heavy . For such type of products ,it is convenient and economical to bring the tools, machines ,men etc. to the work place. This type is also known as 'Static product layout'.

Advantages **1.**Capital investment is minimum.
2. Less total production cost.
3.Continuity of operations
4. Less material movement.

Disadvantages **1.** Machines tools etc. take more time to reach to the work place.
2. Highly skilled workers are required.
3. Complicated jigs and fixtures may be required.

b) What is inventory control ? Explain economic order quantity with the help of a example.

(For Inventory control 02 mark, for EOQ 04 marks, Example 02 marks)

Ans:- Inventory control :- It may be defined as the systematic location storage and recording of goods in such a way that desired degree of service can be made to the operating shops at minimum ultimate cost. To promote smooth factory operation and to prevent pilling up of stock or idle machine time proper quantity of material must be on hand when it is wanted. Proper inventory control can reduce such losses to a great extent.

EOQ

Involves calculation of following cost .

a. Procurement cost

It includes the expenditure made on

1. Calling quotation
2. Processing quotations
3. Placing purchase order
4. Receiving and inspecting.
5. Verifying and payment of bills.
6. Other incidental charges etc.

b)Inventory carrying cost.

It includes the expenditure made on

1. Insurance
2. Storage and handling
3. Obsolescence and Deprecation.
4. Deterioration.
5. Taxes

$$EOQ = \sqrt{\frac{2AP}{C}}$$

A= Total items consumed per year.

P =Procurement cost per order.

C= Annual Inventory carrying cost per item.

Q= EOQ

Example

Let, A = No' of items consumed /year =3000

P= Ordering and setup cost / order = Rs.300

C= Annual Inventory carrying cost/item = Rs.50.

$$Q = \sqrt{\frac{2AP}{C}} = \sqrt{\frac{2x3000x300}{50}} = 189.7 \text{ Say } 190 \text{ Units. Ans.}$$

C) Calculate the standard time for the activity which consists of three elements. The various allowances are given as percentage of the normal time.

(For ST of element 1,2,3: each 02 mark, for TST & ST: 02 marks)

Ans :- Standard time for the Elements 1 = Normal Time + Allowance

NT= OT x R % = 1.2 x 0.8 = 0.96

Allowance = Relaxation + Delay + Personal

= (0.96 x 0.12) +0.96 x 0.05 + 0.96 x 0.06

= 0.1152 + 0.0480 + 0.0576

= 0.2208

standard time for the Elements 1= 0.96+ 0.2208 = **1.1808**

Standard time for the Elements 2 = Normal Time + Allowance

NT= OT x R% = 0.3 x 0.92 = 0.276

Allowance = Relaxation + Del ay + Personal

= (0.276 x 0.14) +0.276 x 0.04 + 0.276 x 0.09

= 0.03864 + 0.01104 + 0.02484

= **0.07452**

Standard time for the Elements 2 = 0.276+ **0**.07452 = **0.35052**

Standard time for the Elements 3= Normal Time + Allowance

NT= OT x R% = 0.60 x 0.86 = **0.516**

Allowance = Relaxation + Del ay + Personal

= (0.516 x 0.16) +0.516 x 0.03 + 0.516 x 0.07

= 0.08256 + 0.01548 + 0.03612

= 0.13416

Standard time for the Elements 3 = 0.516+ 0.13416 = **0.65016**

Total standard time = 1.1808 + 0.35052 + 0.65016

Standard time for the activity = 2.18148 min.

Q 3 a) : Causes of poor productivity (any 4 causes 01 mark for each)

1) Bad Plant Layout :- When the machines and various departments are having incorrect plant layout which results in improper material flow from one operation to another then productivity is affected .

2) Unsafe Working Conditions: - Unsafe Working condition leads to discomfort and fatigue. It lowers the worker's morale and also demotivate the worker thereby gives poor productivity.

3) Exvessive Material Handling: - Unnecessary more material handling decreases productivity. It increases the time required for transfer the material from one work centre to another.

4) Increase of work content:- if work content in man-hour or machine hour is increased, it reduces productivity.

5) Less / Ineffective use of resources: - It is also one major factor to reduce productivity.

6) Lack of number of Combined Operations: - Less number of combined operations decreases the productivity.

7. Use of obsolete machines, tools, etc. :- It gives no good effect rather than to reduce productivity

8. Bad design of the product: Product having unnecessary features not contributing into functions affects productivity.

Q 3 b) : Group Technology & its applications

(03 marks for description & 01 mark for applications)

Group technology is based on the general principle that many problems are similar and by grouping similar problems single solution can be found to a set of problems thus saving time and efforts. This principle can be applied to any branch of engineering. The group of machines are formed so that all the components in one family can be manufactured by one machine group. These machine groups can be arranged in two ways:

a) The group lay out system
b) The group flow line system

In the first system the machines are arranged into groups in such a manner that each group can carry out all the machining operations needed for a family of components for eg. A particular family of component requires machining operations on a lathe, a drilling machine, a milling machine and a lapping machine. These four machines grouped in two cells and located in one small area of the floor space.

In second, the machines are arranged in the sequence of production operations and usually linked by conveyor arrangement.

The Group technology is also known as " Part Family Manufacture"

Applications:

i) Group technology approach is used for manufacturing in automobile industry.
ii) It is used in manufacturing lines of different types of compressors (like screw, reciprocating, rotary, etc.)

Q 3 c) : Principles while designing Jigs & Fixtures

Principle of Jig & Fixture Design (for 8 points each 01 marks)

i) Rigidity: A jig or fixture should be strong enough to withstand cutting forces that are generated during the process.
ii) Clearance between jig / fixture & component: Sufficient space is necessary to allow any variation in component sizes, shapes, etc. and to allow hand movements
iii) Swarf clearance: The awkward little corners in jig or fixture should be avoided to avoid deposition of smaller chips.
iv) Locating points & supports: They should definite, simple, cleanable, also removable.
v) Easy loading / unloading of work: The process of loading and unloading should be easy, quick, positive and simple.
vi) Clamping: There should be proper and adequate clamping provided for work.
vii) Fool proofing: Jigs & fixtures are designed in such a way that the unskilled worker should locate work in a correct way.
viii) Design for safety: Design of jigs and fixtures should provide every safety to the workers.
i) Ejectors: For heavy components ejectors should also be provided.
ii) Trunions
iii) Inserts

iv) Provision of coolant
v) Economy

Q 3 d) : Process operation sheet & its contents

Operation sheet (For 2 marks)

* Operation sheet provide the detailed record of different operation needed to produce a part in a tabular. In short it is also known as analysis sheet, instructional sheet or process design sheet.

* It provide the all the operations which is carried out on the raw materials and also the sequence of that. The operation sheet also gives the standard time required for complete the job on desired machine.

One such usual process operation sheet is shown in figure below.

Operation sheet							
Part name: Part no: Material specification: Quantity: To be completed on:			Job drawing				
Operation no.	Jigs/Fixture	Tools	Speed	Feed	Depth Of cut	Cutting Speed	No of cuts

Operation sheet usually has following **contents or details (For 2 marks)**

- Information of component, its name, number, drawing, etc.
- Information of blank size
- Description of operations in proper sequence
- Type of machine, types of tools, equipment, etc.
- Type of jigs, fixtures, their codes
- Inspection tools / devices
- Cutting data like feed, speed, depth of cut, etc.
- Elements of standard time (machining time, setting time, handling time, etc)
- Job rating of worker for each operation

Q 3 e) : Five S (For 5S meaning 02 marks, for other related information 02 marks)

Terms associated with 5S are as follows:

1. SEIRI / SORTING means segregation
2. SEITON / SET IN ORDER means systematic arrangement
3. SEISO / SHINE means getting rid of waste & making cleanliness
4. SEIKETSU means standardizing
5. SHITSUKE means self discipline / maintain

   5 S may be considered as way of industrial life that brings about self-discipline among employee. There are many benefits of applying 5 S in any organization. Some of important are included as:
   - By applying 5S in industry to systematically achieve total organization, cleanliness and standardization in work piece.
   - By applying 5S results in well organized workplace.
   - By applying 5S results in more efficient workplace.
   - By applying 5S results in more productive operation in workplace.
   - By applying 5S results in boost the morale of the workers.
   - By applying 5S results worker feel proud in their receptive work.
   - By applying 5S results worker realize his responsibility in workplace.

Q 4 a) : i) Need & Importance of Material Handling Devices (Expected 8 points ½ mark each)

Material handling devices are very essential from production point of view. It involves piling, loading, unloading, transporting parts, raw material, finished goods, etc. starting from factory gate right upto finishing end, there are lot of devices/ equipments necessary. Their need and importance is listed below

- To move or position raw material
- To move machines, big equipments as and when required
- To move jigs, fixtures, tools, spares, etc.
- To load finished goods
- To unload raw material from outside
- To position the material for stocking or sale
- To material within department for testing or processing
- To reduce number of manually done processes or activities
- To reduce time, cost, manpower, etc.

Q 4 a) : ii) Comparison of Fixed & Line assembly (expected 4 points, 01 mark each)

Description or Basis	Fixed Assembly	Line Assembly
Concept	When work piece is heavy or very big and difficult to move from place to place	Machines and auxiliary services are arranged in line in accordance of sequence of operations

Type of worker	Highly skilled worker required	Comparatively less skilled
Flexibility of product	More flexibility in context of fixed layout	Less flexibility in Line type
Material movement	Least material movement	Continuous material movement
No of workers	It is possible to carry out work with less number of skilled workers	More number of workers
Example	Assembly of Aeroplane, ship, Heavy size gas compressors, etc	Assembly of Scooter, motorbike, engine, etc.

Q 4 a) : iii) Plant Capacity & Machine Capacity

Plant capacity (02 marks)

It is defined as rate of production in a defined time i.e per month or per year. And if company produces more than one product, the plant capacity is given in terms of available hours per day.

e.g suppose a particular company produces 1000 diesel engine in a year then the plant capacity is 1000 diesel engine per year. Or it may be in per day or per hour basis also.

Machine Capacity:- (02 marks)

Capacity is a rate of output and it is the highest quantity of output that is possible during that time. Machine capacity may be defined as the time-available for work at a machine expressed in machine hours. For example, a machine may have a maximum capacity of 168 machine hours per week.

It is defined as the number of pieces that can be produced through one machine for a given period of time.

Example: M/c capacity of CNC Lathe is 1200 Items /day

Q 4 a) : iv) Line balancing technique in mass production system

(02 marks for concept, 02 marks for description with example)

Line balancing: - Line balancing means balancing the line, for example balancing the production line or an assembly line. The main objective of line balancing is to distribute tasks evenly over the work stations so that idle time of men and machines is minimized.

Each work station should have the same operating time and various operations should be sequenced properly. There should be perfect balance between the output rates of the parts and the subassemblies.

Line balancing aims at grouping the facilities (or tasks) and workers in an efficient pattern in order to obtain an optimum or most promising balance of the capacities and flow of the production on assembly processes. Tasks are grouped so that their total time is preferably equal to or a little lesser than the time available at each work station, this reduces the idle time.

For solving line balancing problems a number of methods are available, for example Heuristic, linear programming model, dynamic programming.

Importance of Line Balancing

* By this the proper utilization of machine is taken place.

* By this there is proper utilization of worker is taken place.

* the idle time for man and machine is minimum in line balancing.

* The production rate is more in line balancing.

* The cost of production is cheaper than other method.

Suppose there are three machines A, B and C which performed the operation for different time (e. g 5, 10 and 15 min) and sequencing of operation on the part is from A to B to C. There if all the machine is one then there is improper utilization of the machine because there is different idle time for different machine so to obtained the proper balance of the machine there is need of more B machine and C than A machine so that there is less idle time for the machine.

Q 4 b) : i) Plant efficiency and affecting factors

Plant Efficiency (For 2 marks)

*It is defined as the ratio of actual (Effective) working hours in the plant to the total working hours available in the plant for the same period.

***** Plant efficiency factors varies from machine to machine and company to company and it is in between 0.5 to 0.95

*e.g if the actual working hour in industry for particular week is 150 hr and available hour in industry is (24 x 7= 168) then plant efficiency is given by = 150/ 168= 0.893 or 89.3%)

Affecting Factors: (Expected 4 points for 4 marks)

- Plant layout
- Availability of modern machines and tools
- Working conditions
- Types of inputs (Such as material, type of process, etc)
- Amount of scrap
- Effective use of available time
- Less number of break down hours

Q 4 b) : ii) Functions of Automated Guided Vehicle (A G V) System

Functions **(any 6 points each 01 mark)**

i) AGV is the programmed vehicle used to carry load from one location to another in an automated work place.
ii) To follow a predetermined path on embedded wires into the ground.
iii) It should be able to select its own route or path to reach the destination without any human interaction.
iv) It should be totally driverless i.e. it should not require any manual steering guidance or control.
v) It should have an effective interface to get connected with robots, automatic systems, etc.
vi) It must handle any part of any size without much modification in it.
vii) It should eliminate amount of labour or possible damages
viii) It should be capable of having off-board controller is used for instructions for loading and unloading of the load.
ix) AGV should function to handle variability in the production rate or changes in product routing
x) It should be capable to operate in most hazardous conditions.
xi) Host computer is essential for the shop floor control and co-ordination of AGV system.

Q. 5 (a) Poka Yoke (Description – 4 marks)

Poka Yoke is sometimes referred to in English by some people as " fool proofing " or " error avoidance" or " mistake proofing" or " fail- safe operation".

The main objective of Poka Yoke is to achieve zero defects; the main goal is that to eliminate defective products.

Poke Yoke is more of a concept than a procedure. Thus its implementation is governed by what people think they can do to prevent errors in their workplace and not by a set of step-by- step instruction on how they should do their job.

e.g Suppose a operator operate the machine at night if he feel tired but in industry there is no provision for sleep and if the worker is still doing his task then there is chance to produce the part with some defect or there is chance that machine is going in wrong way then Poka Yoke device are usually used to stop the machine and alert the operator if something is about to go wrong. In this way the quality of job is maintained within the range.

Q. 5 (b) Method study & its objectives (Definition 2 marks, any four objectives – 2 marks)

Method study: -Method study may be defined as the systematization of the existing method of doing a job in order to develop and install an easy, rapid, effective and efficient procedure for doing the same job using available resources and at lower costs.

Objectives:-

1. Improvement in process and procedure.
2. Improvement of factory shop and work place layout.
3. Improvement of the design of part and equipment.
4. Reduction of unnecessary fatigue and economy in human effort.
5. Improvement in the use of materials, machines and manpower.
6. The development of better working environment.

Q. 5 (c) Technique of Micro motion study (Description – 4 marks)

" Micromotion study is a set of techniques intended to divide human activity into groups of movements or micro-motions (Therbligs) and the study of such movements helps to find for an operator one best pattern of movements that consumes less time and requires less efforts (or fatigue) to accomplish the task."

Micromotion study technique is best suited for those operations which are short in cycle and which are repeated thousands of times (such as the packing of sweets into boxes). In such operations it is worthwhile to go into much greater details to determine where movements and effort can be saved and to develop the best possible pattern of movement, thus enabling the operator to perform the operations repeatedly with a minimum of effort and fatigue.

Micromotion study is one of the most accurate methods of work analysis used for job improvement. It makes use of motion pictures of activities taken at a predetermined constant speed. The film thus taken becomes a permanent record of the method being used and the time consumed in doing the work. Micromotion study provides a technique which is capable of making a minute analysis of any operation.

Q. 5 (d) (Any two differences each for 2 marks)

Jigs:- 1) A jig is a device which holds and positions the work , guides one or more cutting tools relative to the work piece.
2) A jig usually is not fixed to the machine table.
3) It is lighter in construction.
4) Jigs are used on drilling, reaming, tapping and counter boring operations.

Fixture:- 1) A fixture is work holding device which only holds and positions the work, but does not guide the cutting tool.
2) A fixture is bolted or clamped to the machine table.
3) It is heavy in construction.

Q. 5 (e) Advantages of two Bin system: (2 Marks)

1) It is simple and reliable
2) It is comparatively cheap to operate and easy to explain to new stock control personnel.
3) Reorder point is indicated easily.

Disadvantages of two Bin system: (2 Marks)

1) When different items have to be ordered from the same supplier in order to reduce transportation cost, it is necessary to order several items simultaneously, even when only one reaches the reorder point, while the basic idea of the two bin systems is that items are independent of each other in the replenishment procedure.
2) Because of absence of adequate data on stock levels and consumption rates in the simpler form, it is difficult to re-evaluate order quantity.

Q. 5 (f) : MRP & its objectives (Definition 02 marks , Objectives 02 marks)

Material requirement planning is a computer- based inventory management system designed to assist production mangers in scheduling and placing orders for item of dependent demand. Dependent demand items are components of finished goods such as raw materials, component parts and subassemblies for which the amount of inventory needed depends on the level of production of the final product.
MRP processing first determines gross material requirements, then subtracts out the inventory on hand and adds back in the safety stock in order to compute the net requirements.

Objectives of MRP systems to manufacturing firms include helping production managers to minimize inventory levels and the associated carrying costs, track material requirements, determine the most economical lot sizes for orders, compute quantities needed as safety stock, allocate production time among various products and plan for future capacity needs. It guarantees that finished products can be produced and delivered in a timely manner.

Q. 6 (a) 3-2-1 principle used in jigs and fixtures (4 Marks)

According to this principle, only the minimum locating points should be used to secure location of the work piece in any one plane.

Considering 3-2-1 principle, three pins are used in the base of the fixed body because this is the minimum number of locating points through which a plane can be drawn on which the work piece will seat. Now, considering the second plane, if only one locating point is provided the work piece will swivel, about this point, but it will not swivel if two locating points are provided. These two locating points establish a line parallel to the first plane. With the work piece locating against a plane and a line, it has only one direction of movement in third plane. Therefore only one locating point is sufficient in the third plane to restrict this movement.

Q. 6 (b) Single piece production system (4 Marks)

Introduction

One-piece flow describes the sequence of product or of transactional activities through a process one unit at a time. In contrast, batch processing creates a large number of products or works on a large number of transactions at one time – sending them together as a group through each operational step. In one-piece flow, focus is on the product or on the transactional process, rather than on the waiting, transporting, and storage of either. One-piece flow methods
need short changeover times and are conducive to a *pull* system.

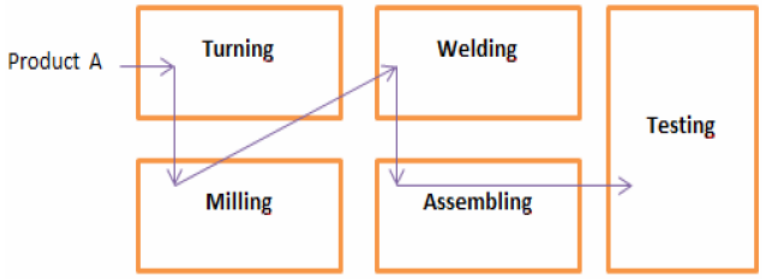
Achieving one-piece flow

While many are familiar with the terminology, there is still a significant amount of confusion regarding what one-piece flow means and, more importantly, how to achieve it. Let us begin by stepping back and attempting to understand the concept of “connected flow.”
Achieving connected flow means implementing a means of connecting each process step within a value stream. In a typical MRP batch-and-queue manufacturing environment as illustrated below, parts move from functional area to functional area in batches, and each processing step or set of processing steps is controlled independently by a schedule.

There is little relationship between each manufacturing step and the steps immediately upstream or downstream. This results in:

- Large amounts of scrap when a defect is found because of large batches of WIP,
- Long manufacturing lead time,
- Poor on-time delivery and/or lots of finished goods inventory to compensate,
- Large amounts of WIP.

Figure shows single piece flow of material of product A through different processes.



Q. 6 (c) The equipments uses for time study are (Any 4 points, 04 marks)

1) Stop Watch- The two types of stop watches commonly used for time study are :

i) Flyback decimal minute stop watch

ii) Non – flyback stop watch

2) Time Study Board – It is simply a flat board, usually made of plywood, hard board or a plastic sheet. It is provided with the fittings to hold the stop watch and a strong spring clip to hold the time sheet.

3) Time Study Forms- Printed forms are used for recording the observations during time study. It ensures that, time studies are made in a standard manner and that no essential data are omitted.

4. In addition to this, in the study office a calculator, a reliable clock, with a second hand and measuring instruments such as a tape measure, steel rule, micrometer, spring balance etc. are used.

Q. 6 (d) ABC analysis (4 marks)

ABC analysis 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.

A: - Items are high valued items but are limited or few in numbers. They need careful and close inventory control.

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.

C: - Items are low valued but maximum number of items. These items do not need in any a control rather controlling them is uneconomical. They are generally produced just before they finish.

Q. 6 (e) Two handed process chart for the process of filling ink in fountain pen

LEFT AND RIGHT HAND CHART

Job :- Filling up ink in fountain Pen

Chart begings :- Both Hand empty

Left Hand Description	Symbol	Symbol	Right hand Description
To fountain Pen	⇦	⇨	Reach for ink dropper
Grasp Pen	○	○	Grasp ink dropper
		○	Fill the dropper
To position	⇨	⇦	Carry ink dropper to fountain Pen
Hold fountain pen	▽	○	Fill the ink in fountain pen
Reach to Pen holder	⇦	⇨	Return ink dropper to place
Release Pen in holder	○	○	Release ink dropper
move hand	⇨	⇦	move Hand.