Unit-II

Operations Management

Plant location and layout :-

Plant location deal with where the plant is to be located plant layout refers to the method in which the machinery is laid out within a given plant area.

Plant location :-

It is a strategic decision. The main objective of any forgor is to optimise its costs and revenues, that is, minimise its costs and maximizing its returns. The plant should be located in such a place where the large-scale economies accrue.

factors affecting plant location :-

The factors governing the decisions of a plant location are.

- → closeness to raw materials
- → Nearby markets
- → fuel and power
- → Transportation
- → Availability of labour
- → Natural and climatic factors.
- → Govt influence
- → political interference
- → other considerations | factors.

plant layout :-

It is defined as the Process of determining a spatial layout for a collection of physical Prodn facilities suitable to manufacture a Pdt & Provide a Service. It is concerned with

- → mfg and Servicing dept's
- → machinery
- → Individual work places.

Significance:-

→ Change in Pdt design leads to change in operations (Sequence & new operations
→ New pdt manufacturing
→ Increase in o/p by using additional / upgrading present machinery and replacing obsolete by new machinery.
→ Increase in capital utilisation.
→ Working conditions (Congestion (&) uncomfortable)
→ Shifting to new location (plant).

Advantages and Disadvantages :-

Advantages	Disadvantages
→ Minimise unit cost and optimise quality	→ material handling cost will be high.
→ Effective utilisation of People, Equipment, Space & Energy	→ Prodn time is lost because the workers keep moving between diff. work stations.
→ Employee's convenience, safety and comfort	→ Working conditions cannot be safe.
→ Control Project costs	→ prodn costs gets jacked up. and Return on capital employed may be low.

Systems of plant layout:-

plant layout is a specialised process. The pattern is a r/p btn the no of Pdts (P) and the Prodn quality (Q).

The major systems of plant layout are.

→ Product layout

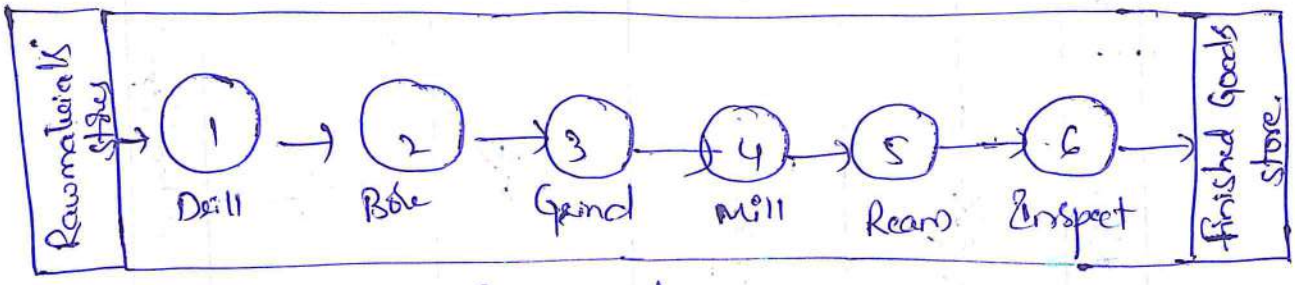
→ Process layout (or) functional layout

→ fixed layout.

Product layout :-

In the Pdt layout, to meet the mass Production requirement Prodn facilities and auxiliary services are located based on the Process details of the given Pdt to be manufactured.

The logical sequence in the Prodn Process forms the basis for the arrangement of machinery under this layout. This facilitates a high degree of automation to minimise fatigue of ease.



Product layout

Advantages :-

→ faster and cheaper Production

→ material handling cost is low.

→ Easy monitoring

→ floor space utilisation is max.

→ Team work benefits

Disadvantages :-

→ Threat of duplications

→ Huge capital outlay

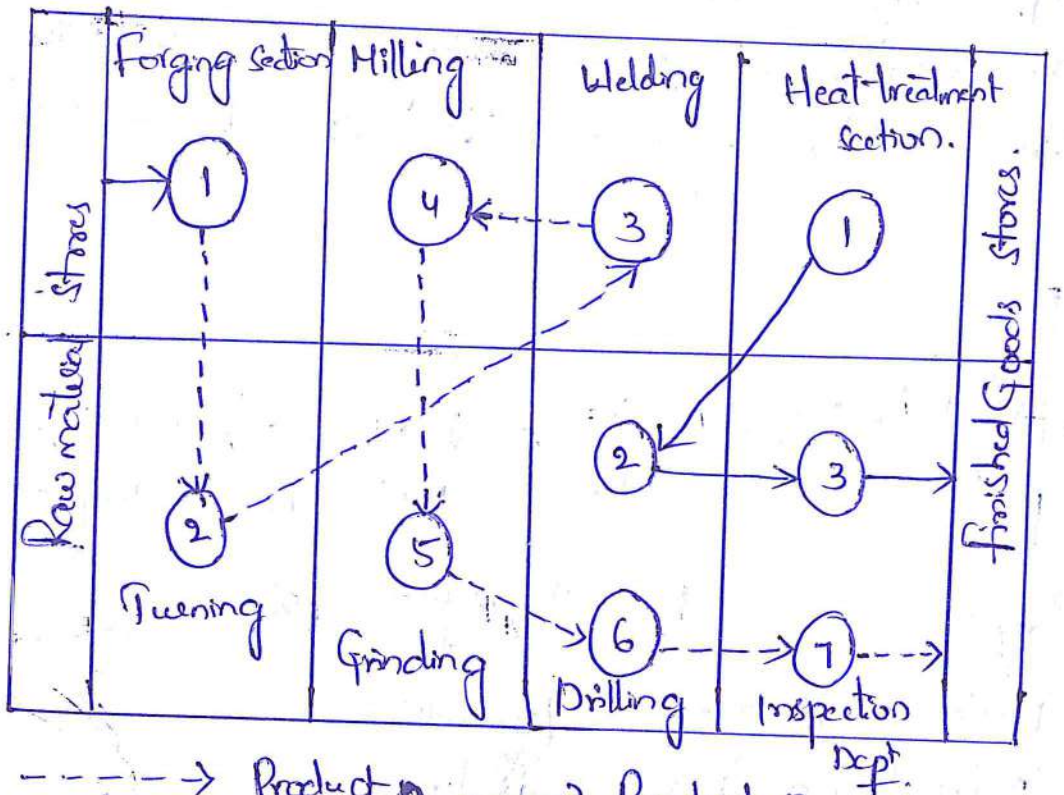
→ low flexibility

→ monitoring each worker is difficult.

Process (or) functional layout :-

If the equipment is arranged as per the nature or types of the given set of pdts operations major is called process layout.

In the case of small o/p, jobbing, or small-lot prodn machines and services of like-types are located together as work centers in one area of the plant.



Process layout

Advantages :-

→ Optimum utilisation of resources
→ flexibility
→ Continuity
→ monitoring
→ Interesting to workers.

Disadvantages :-

→ Material handling costs is high
→ Larger Prodn cycle
→ Monitoring may be complex
→ Higher inspection costs
→ Higher wage bill.

fixed layout :-

The layout in which the manufacturing facilities are fixed in their position and cannot be shifted from one place to another. This layouts are used in large projects such as building ships, manufacturing of aircrafts, heavy pressure vessels, and automobiles, construction of oil rigs etc.,.

Advantages :-

→ Does not involve large investment
→ High degree of flexibility relating pdt design, pdt mix and prodn volume.
→ Job-enlargement can be effectively practised.

Disadvantages :-

→ Material-handling costs will be very high.
→ under utilisation of resources will be caused due to unplanned prodn (@ Jobs no)

Productivity & Production :-

Productivity :- It is defined as the rate at which the goods and services are produced. It is relationship between the inputs and the outputs.

$$\therefore \boxed{\text{Productivity} = \frac{\text{output}}{\text{Input}}}$$

Productivity is also called the efficiency of the inputs.

Production :- The process of conversion of inputs ie., Raw materials into desired level of outputs ie., End products / final products is called product-

Methods of Production :-

Production can be of

(a) Intermittent & ~~interup~~ interrupted Prodn which includes

→ Job Production

→ batch Production

(b) Mass and flow line Production.

Job Production :-

Every job is diff from one to other in terms of type, cost, efforts, consumption of materials, or its specifications. As a result Prodn design could consume a lot of time. It involve special machinery, and training for the labour. Mechanisation and division of labour cannot be advantageously employed in view of the wide differences in the specification of each job.

Batch Production :-

Here, all the Products manufactured under a batch are of similar in terms of type, cost, efforts, consumption of raw materials or the specifications. Though the Product design consumes a good amount of time, the cost of Pdt design per unit could be lesser.

When compared to the costs in job production, the cost per unit in batch production is lower. Flow of materials in the manufacturing process can be continuous'.

Ex:- Pharmaceuticals, readymade garments, Sheet-metal parts. Presses, Paints, etc,.

(b). Mass Production:-

This is also called flow Production. The Production can be undertaken on large and specialised machines and Processes. In mass Production, the following factors can be advantageously employed:

→ Mechanisation and division of labour
→ large-scale economies
→ Sophisticated material handling Systems to minimise the material handling costs.
→ work study techniques
→ Quality control techniques like ISO 9000.

The Prodn Process have to be carefully monitored as Idle machinery results in the wastage of the product. resources. and the plant layout should be designed to suit the requirements of the various stages in mfg the pdt. The main advantage of this method is the lowest unit cost of Production.

Work Study:-

Defn:- Acc to British standard (BS 3138), work study refers to the method study and work measurement, which are used to examine human work in all its contexts by systematically investigating into all factors affecting its efficiency and economy to bring forth the desired improvement.

Work study has two parts: method study (also called motion study) and work measurement (also called Time study)

Method study Precedes work Measurement. Method study deals with the techniques of analysing the ways to do a given job better.

Benefits :-

→ It leads to standardisation of the Job Procen
→ Determines the cost of the work.
→ Enhances the Productivity of the workers and Machines.
→ Enhances employee morale, fasn incentives.
→ Helps to evaluate the performance of an employee or dept.
→ It facilitates the orgn to plan and achive work targets.

Contributions:

Gilbarth's :-

Frank B. Gilberth and Lillian Gilberth worked in the areas of method study and work measurement. They examined many specified jobs of diff industrial orgns.

While conducting the study, in work study, they quoted "therblig". It is a small symbol used to represent a specific body movement while writing down a particular task as a series of component motions.

Work study is relatively low-cost way of designing work for high Productivity. It is applied to improve productivity in the existing work by improving the present method and existing resources can be redesigned (or) relocated.

Application:-

Work Study is to be applied, in such as which are likely to yield max returns in the years to come. The results include increase in Production, wastage reduction, improved safety etc.,

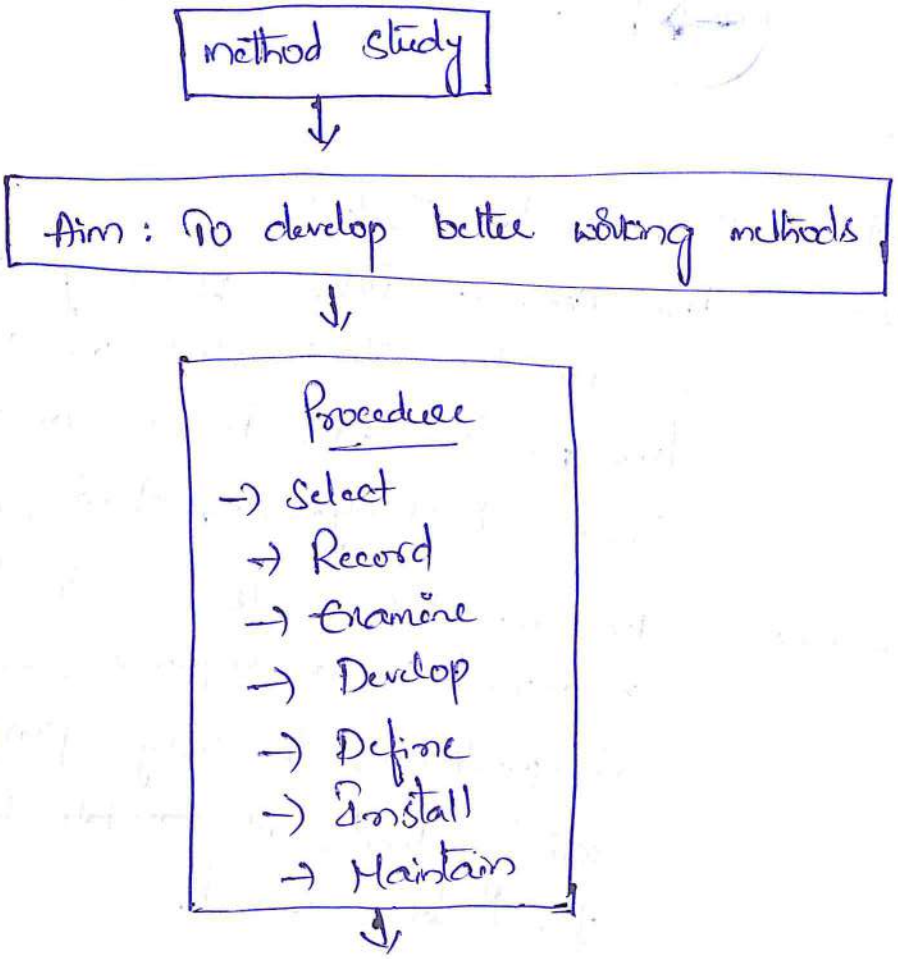
The factors to be considered to employ work study are:

→ Anticipated life of Job.
→ Cost and utilisation of Equipment, Machines, tools and soon.
→ Importance of the Job.

Method study :-

Method study is the systematic recording and critical examination of the existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods, reducing costs and increasing efficiency. It attempts answer questions of the type : what ? when ? how ? who ? and where ?

Method study is used in order to effect a sol's to a variety of Prod? Problems. Such as workplace layout, equipment design, Product / Process design, worker fatigue etc,.



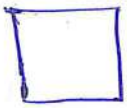
Record :- Process chart symbols

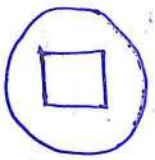
 — operation

 — Transport.

 — storage

 — Delay.

 — Inspection

 — operation — cum — inspection

 — operation — cum — Transportation.

Procedure :-

→ Select — Task to be studied

→ Record — The current process of doing the job has to be recorded it involves prodn, inspection, transporation etc, It can be done using process chart symbols, charts, diagrams

→ Examine — The recorded events are to be critically examined in a sequence, even to the extent of questioning the very purpose of an activity. Thus, all possible basic questions should be answered.

Person — who ? why ? why does not.

Purpose — why It is to be done.

place — where ?

Sequence - when it is to be done?
method - How is it done?

→ Develop and Define -
Based on the data, the alternative methods of doing the same job more effectively, are to be identified and evaluated.

→ Install - The new method so developed to be installed in phased manner.

→ Maintain - Once the new method starts yielding the desired results, it is necessary to maintain the new method without any change for sometime.

Recording techniques :-

The recording techniques are of three types :
Process charts, diagrams and motion & film analysis.

Process charts :-
→ Outline process chart
→ Flow process chart
→ Two handed process chart
→ Multiple activity charts.

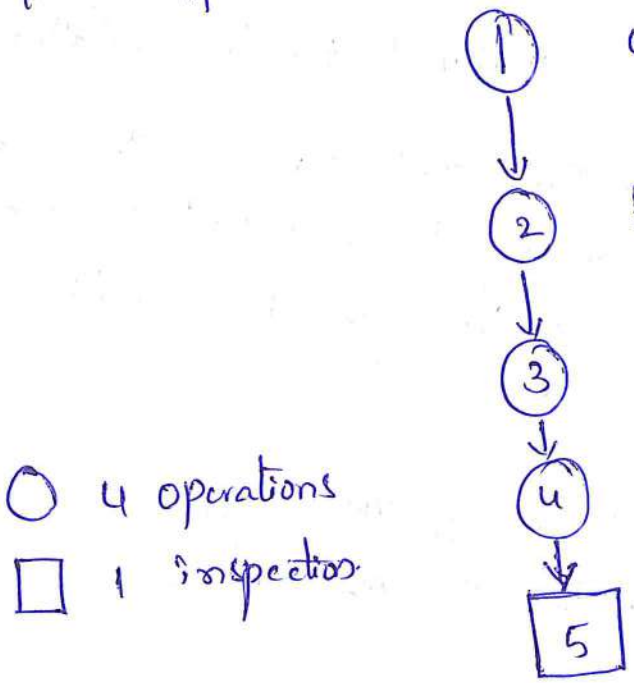
Diagrams :-
→ flow diagram
→ String diagram
→ Cyclegraph
→ Chronocycle graph

Motion and film Analysis :-

Therbligs are basic unit of work activity used in micro motion studies, which are detailed studies of repetitive work.
SIMO are used — Simultaneous motion cycle charts.

Outline Process charts :-

This chart outlines the basic Process of the job in terms of two elements such as operations and inspection. This constitutes the basic step for the beginning of a detailed analysis. The sequence of the elements is made clear by numbers.



Two-handed Process chart :-

This records the activities of the left hand and right hand as related to each other.

Ex:- Typing, Watch repair, nail hitting, Cooking, repairs of electrical goods etc;.

The Process of this chart is to depict the existing method of doing the job.

Job: Nail Hitting:			
Left hand	Symbols		Right hand
	Left hand	Right hand	
Pick up nail			Pick up the hammer
fix the nail at the required point on the box			Idle
Hold			Strike
Idle			Inspect.

Summary:

Left hand	Right hand.
○ 2	○ 2
D 1	D 1
▽ 1	▽ nil
□ nil	□ 1

Two handed Process chart.

The Summary statement is a valuable piece of information for further probing.

Flow Process chart :-

It provides information about the time taken for all the events and the distance involved for movement of work, materials, machinery and men. The flow Process chart can be of three types : man type (records only what the man does)

material type (" " what happens to material)

Equipment type (" " what happens to Equipment)

The details mentioned are used to further explore the possibility to reduce or integrate some of the operations, minimise the delays by better planning, or by reducing the distance involved in the movement of men, materials and others.

It provides an overview of the Processes in the existing lay-out. Based on this, it is critically examined if any modifications / improvements can be proposed any to bring any changes in terms of Process.

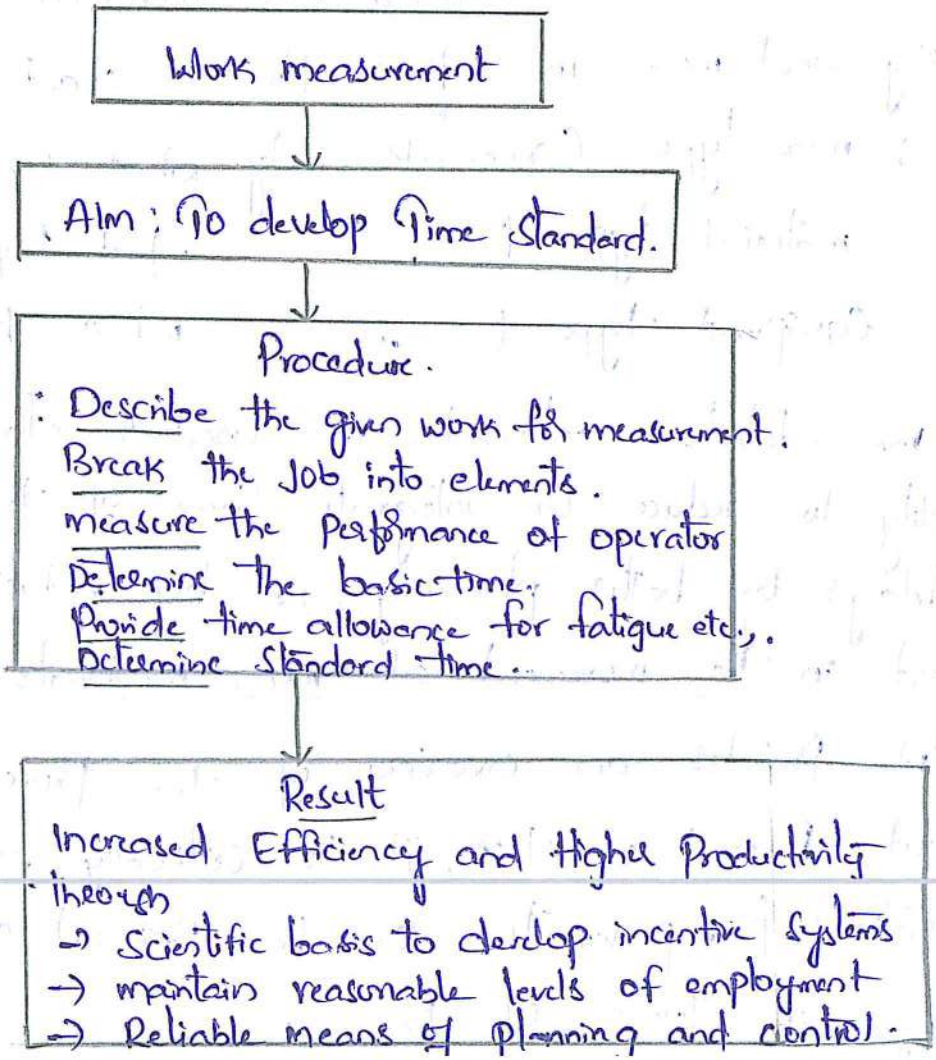
Work measurement :-

It is also called time study, it establishes the time taken by a qualified worker to complete a specified job at a defined level of performance.. These are used to answer — how long ? and when ?

Results :-

- → Developing Costing Systems.
- → Determining Prodn Schedules.
- → Developing incentive Schemes.
- → Comparing time taken between alternative methods of a given job.
- → To standardise the job in terms of standard time, thus, supplementing the efforts of method study.

Procedure :



Time Study Equipments :-

These can be broadly classified into two types

(i) time measuring devices
(ii) time study boards and time study charts.

(i) Time measuring devices

(a) Stop watch — Decimal minute - stop watch
Decimal hour stop-watch.

(b) motion picture camera
(c) Time recording machines
(d) Electronic Timer.

Time Study boards :-

These are simple and hardy hard wood boards Equipped with stopwatch holders and clamps for holding the observation sheets and time study forms.

No. of observations :

$$N = 40 \sqrt{\frac{n \sum (fx^2) - (\sum fx)^2}{\sum fx}}$$

where $n = \sum f$ = no of observations taken.

N = No of observations required for 95 percent Confidence level and ± 5 percent accuracy

X = Value of observation.

Normal time and standard time:-

Rating the job enables a normal basic time to be established using the following formula:

$$\text{Normal or Basic Time} = \frac{\text{Observed time} \times \text{Rating}}{\text{Standard rating}}.$$

Ex:- If the time for a particular element observed is 0.20 mins, it is rated as 120, then

$$\text{Basic time} = \frac{0.20 \times 120}{100} = 0.24 \text{ minutes}.$$

In order to reach standard time, a no of allowances are added to the basic time. If it is decided that an allowance of 0.06 mins to be added to the basic time; the standard time arrived at as follows:

$$\text{Standard Time} = \text{Basic time} + \text{Allowance Time}$$
$$= 0.24 \text{ mins} + 0.06 \text{ mins}$$
$$= 0.30 \text{ mins}.$$

Time study ends with determining the standard time.

Applications:-

- → Rate of efficiency of worker can be assessed.
- → Incentives for the time saved can be determined.
- → Jobs of similar nature can be compared with one another.
- → The impact of change in working conditions on the efficiency of the worker can be determined.

Standard time:-

Def:- The amount of time required to complete a unit of work under given working conditions & machinery.

Work Sampling :-

This is used to know the percentage of idle time for workers in a factory with hundreds of machines and thousands of workers. and to establish the standard time for an operation and also to fix the performance rate.

This is a technique in which large no of observations are made over a period of time for either a single machine, Process or worker of group. This is also called activity sampling.

No. of observations.

$$S_p = 2\sqrt{\frac{p(1-p)}{n}}$$

or

$$n = \frac{4p(1-p)}{S^2 \times p^2}.$$

where

S = desired relative accuracy

p = % occurance of an activity or delay being measured

n = total number of observations (Sample size)

Statistical Quality control (SQC) :-

The process of applying statistical principles to solve the problem of controlling the quality control of a product or service is called statistical quality control.

In 1931, W. A. Shewart introduced, the control charts on the basis of statistical principles. These are used to ensure quality.

Quality → Quality of design
Quality → Quality of Conformance.

Quality of design refers to pdt features such as performance, reliability, durability, ease of use, etc;.

Quality of conformance refers to whether the product meets the given quality specifications or not. In SQC, we are concerned with the quality of conformance.

Inspection:-
The process of measuring the output and comparing it to check whether it meets the given specified requirements or not, is called Inspection.

Its main objective is to determine the conformity of the goods so produced to their specifications in terms of measurements, composition, strengths etc;.

Purpose:-
→ To determine process deviations
→ To filter defectives.
→ To measure process capability
→ To minimize cost,
→ To rate the inspectors efficiency and accuracy.

Inspection and Testing:-
Inspection emphasises conformance of a pdt to a given standard where as Testing is used not only to determine conformance but also to evaluate a new design, diagonise problems, or make adjustments or error corrections.

Inspection Methods:-

Incoming inspection
Critical point inspection.

Process inspection / Patrolling inspection / floor / roving inspection.
fixed inspection
final inspection.

Elements of Statistical Control of Quality Control :-

The techniques under SQC can be divided into two parts

(a) Process control
(b) acceptance sampling.

Statistical Quality control

- Process control is carried out through
  - Control charts
    - for Variable
      - $\bar{X}$ charts
      - R charts.
      - σ charts*.
    - for attributes.
      - 'c' charts for no of defects per unit.
      - 'p' charts for defectives in a given sample.
- Acceptance Sampling is carried out through.
  - Single sampling plan
  - Double Sampling plan
  - Multiple Sampling plan
  - Sequential Sampling plan.

Process control :-

Process control is a technique of ensuring the quality of the products during the manufacturing process itself. Process control is achieved through control charts. It aims to control and maintain the quality of the parts in the mfg process.

Statistical control charts :-

A control chart compares graphically the process performance data to computed statistical control limits. These control limits act as limit lines on the chart. control charts are the tools to determine

whether the Process is under control or not. The main objective of a control chart is not achieve the state of statistical control but to identify process variation and generate back ground info helpful to reduce the same.

Confidence limits and control limits :-

Confidence limits indicate the range of confidence level. A confidence level refers to the probability that the value of a measurement of parameter is correct.

Control limits are used to decide whether the variation found in the prodn process is desirable or undesirable. These are found in the control charts. These are determined based on the Principles of normal distribution. Control limits are of two types upper control limit (UCL) and lower control limit (LCL).

Confidence limits are calculated by means of standard deviation (σ).

Advantages of control charts :-

→ The inspection work is less as goods produced are inspected by samples.

→ The control charts for variables and attributes focus on the assignable causes and helps to bring a substantial improvement in pdt quality. Thus, they reduce the need for spoilage & re work.

→ These help to determine the process capability is compatible with the specifications or not.

→ These highlight when the process is likely to be out of control and also when the tools need to be better planned, adjusted, or reset.

Annamacharya Institute of Technology & Sciences, Kadapa.

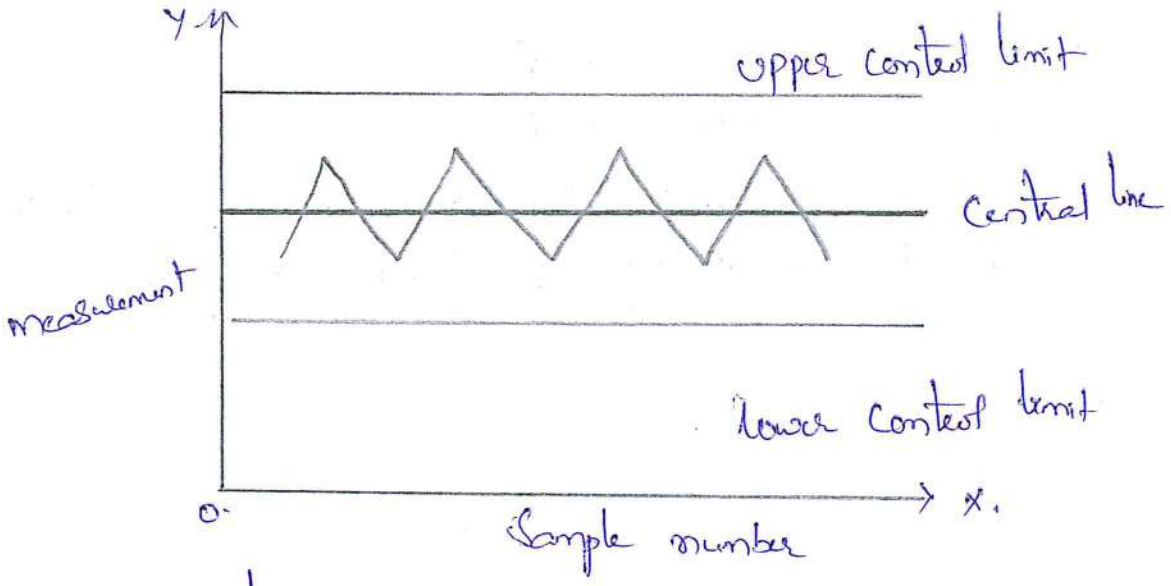
III B.Tech I semester I mid term Examinations feb 2018.

Name of the Subject: Management Science. Branch: E

Time: 90 mins Max. marks: 30

Answer any three questions

① Define Management



Control chart

Control Charts for Variables :-

A Variable is one whose quality measurement changes from unit to unit. The quality of these variables is measured in terms of hardness, thickness, length and so on. These are drawn using the Principles of normal distribution.

These are usually designed to test the means of samples tend to be distributed normally though the actual variables resulting from a process do not conform to the normal distribution. This tendency is called central limit Theorem.

$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ where $\sigma_{\bar{x}}$ = standard deviation of mean values of samples.

σ = S.D of individual samples.

n = Sample size.

Control charts for variables are of two types : $\bar{X}$ and R chart

$\bar{X}$ and R charts are plotted on seperate charts against their $\pm 3\sigma$ limits. The formula for the control limits on sample average are

for $\bar{X}$ chart

$$UCL = \bar{\bar{X}} + A_2\bar{R}$$
$$LCL = \bar{\bar{X}} - A_2\bar{R}$$

where $\bar{\bar{X}}$ – mean of means

$\bar{R}$ – mean of sample ranges

A_2 = constant taken from the table of constants.

for R chart : $UCL = D_4 \bar{R}$

where, $LCL = D_3 \bar{R}$

D_3, D_4 are constants from the table of constants.

$\bar{R}$ is the average of sample ranges.

Ex:-

Control charts for Attributes :-

The quality of attributes can be determined on the basis of "yes & no" or "go or no go". The control charts for attributes are of two types 'c' charts and 'p' charts.

'c' charts : It is used where there are a no of defects per unit. It controls the no of defects per unit. Here the sample size should be constant. It reveals the pattern of the quality.

$$\therefore UCL = \bar{c} + 3\sqrt{\bar{c}}$$

$$LCL = \bar{c} - 3\sqrt{\bar{c}}.$$

where $\bar{c}$ = Total number of defects in all the samples / Total no of samples inspected.

Ex:-

'p' chart :- It is used where there is data about the no. of defectives per sample. It is also called fraction defective chart & percentage defective chart. Data collection costs and efforts are relatively less under this method. Hence, if the sample size is larger, the results could be better.

$$UCL = \bar{p} + 3\frac{\sqrt{\bar{p}(1-\bar{p})}}{n}$$

$$LCL = \bar{p} - 3\frac{\sqrt{\bar{p}(1-\bar{p})}}{n}$$

Where average defective $(\bar{p})$ = $\frac{\text{Total no of defectives found}}{\text{Total no of pieces inspected.}}$

and 'n' refers to no of pieces inspected per day.

Ex:-

Benefits of SQC :-

→ Helps to identify the causes of variations in quality and minimis the same.
→ It helps to control, maintain and improve the quality standards
→ It facilitates the manufacturer to give guarantee for his pdts.
→ It reduces the wastage, scrap, cost per unit and inspection costs.

Inventory Management :-

It is an integrated functioning of the different sections of a co. dealing with the supply of the materials and other related activities so as to obtain maximum co-ordination and optimum minimum expenditure on materials.

Inventory :-

Inventory is a stocks of materials that are used to facilitate Prodn. These include raw materials, finished and semi-finished goods, spare parts and other consumable materials.

Inventory Control :-

It refers to the Control of raw materials and other inventories ie., achieving an optimum balance between demand and supply.

It is the scientific method of finding out how much stocks should be maintained in order to meet the production demands and be able to provide right type of material at right time in the right quantities at competitive prices.

Objectives :-

→ It aims to minimize the costs of inventory.
→ To Provide Safe and Suitable Storage
→ To ensure optimum utilization of men and machines.
→ To prevent loss of materials during transportation and storage.
→ To Procure good quality materials.
→ To achieve Production targets.

Factors affecting Inventory Control :-

→ Sudden changes in the Prodn plans.
→ Increases in the material prices.
→ Excessive storage costs.
→ Stock-out costs.
→ Increasing lead time.

Precaps:

Prescient

Inventory Control methods :-

1. Economic order Qtod Quantity (EOQ)
2. ABC analysis.

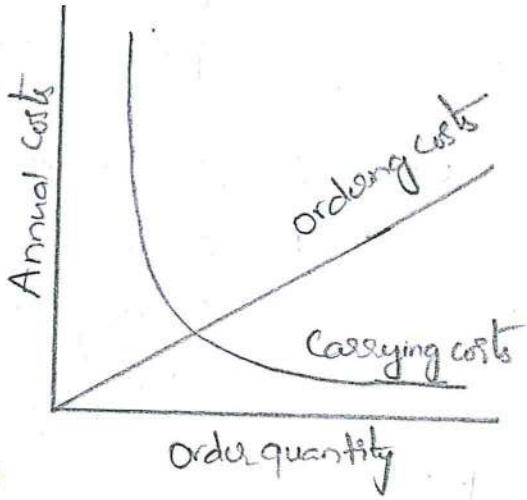
Economic order Quantity :-

It is defined as that quantity of material, which can be ordered

at one time to minimise the cost of ordering and carrying the stocks. In other words, it refers to the size of each order that keeps the total cost low.

Inventory costs:-

(a) Inventory ordering costs
(b) Inventory carrying costs.



Determining the EOQ:-

The EOQ is that quantity of order, which minimises the related material costs, the ordering costs and carrying costs.

$$Tc = \text{Ordering cost} + \text{carrying costs}$$

$$Tc = OC + CC.$$

∴ EOQ is that order quantity at which the total cost is minimum.

Algebraic method:-

Let us define EOQ variables as follows.

A = Annual demand
S = Size of each order (units per order)
O = Ordering cost per order
C = Carrying cost per unit.

Step I:- find out the total ordering cost (TOC) per year.

$$TOC \text{ per year} = \text{No of orders placed per year} \times \text{Ordering cost per year}$$

$$= \frac{A}{S} \times O$$

Step II: TCC per year = Avg inventory level × CC per year.

$$= \frac{S}{2} \times C$$

Step III: Determine EOQ.

$TOC = TCC$ so

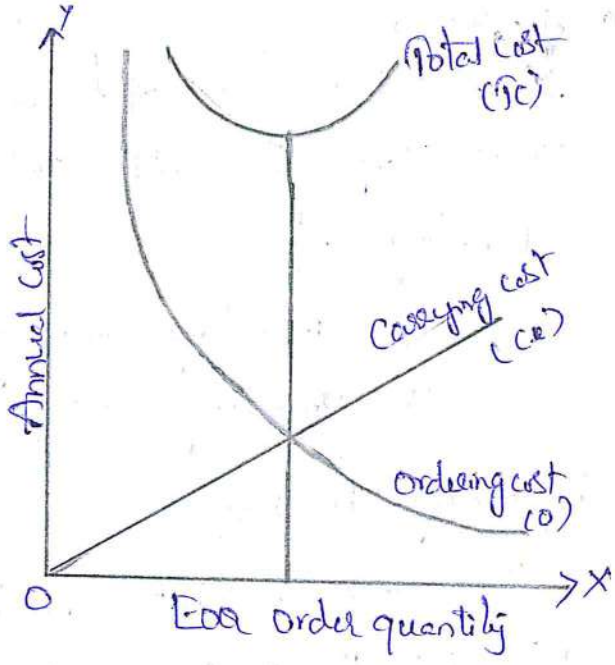
EOQ is one where $TOC = TCC$ or

$$\frac{A}{S} \times O = \frac{S}{2} \times C$$

$$2AO = S^2 C$$

$$S^2 = \frac{2AO}{C}$$

$$\boxed{S = \sqrt{\frac{2AO}{C}}}$$



where S = Size of the EOQ

A = Annual demand in units.

O = Ordering cost per Order

C = Carrying cost per unit.

Ex:-

The following info is about the shock absorbers used by an automobile workshop;

Annual demand : 4800 units

Unit price : Rs. 300.

cost of placing an order = Rs 50.

Storage cost – 3 per cent per annum.

Interest rate – 15% per annum.

Calculate EOQ and also find the no of orders to be placed.

Sol:-

$A = 4800.$

$O = Rs.50$

C = Storage cost (3%) + Interest rate (15%) P.a. P.a.

= 18% Pa. of the unit cost

$= 300 \times \frac{18}{100} = 54.$

$$\therefore EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2 \times 4800 \times 50}{300 \times 0.18}}$$

$$= \sqrt{\frac{2 \times 4800 \times 50}{54}} = \sqrt{\frac{4,80,000}{54}}$$

$$= \sqrt{8888.88}$$

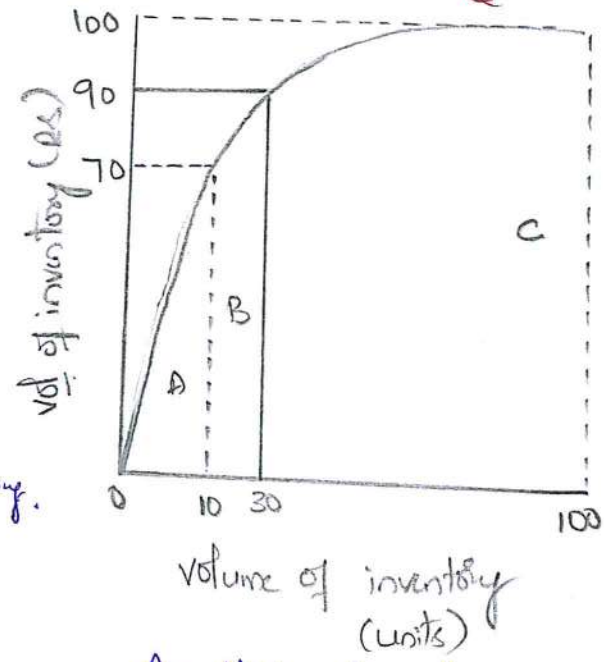
$$= 94.28 \text{ units}$$

No. of orders to be placed

$$= \frac{4800}{94.28} = 50.91 \text{ (or) } 51 \text{ orders}$$

ABC Analysis — A tool of inventory control

It is a technique of controlling inventories based on their values and quantities. (It can be simply remembered as "Always Better Control"). All the inventory items are listed in the descending order of values showing quality held and their corresponding value and then it is divided into three categories — A, B, C.



A- High value items
B- Medium value items
C- Low value items.

Category A - Comprises of inventory which is very costly and evaluable.
- 70% of the funds are tied up in costly stock which will be around 10% of the total vol of stocks.
- Requires strict day-to-day monitoring.

Category B - less costly inventory.
- 20% tied up in such stock and accounts 20% of total vol of stocks
- Requires weekly ~~mon~~ or fortnightly monitoring.

Category C - Comprises less costly inventory.
- 70% of the total cost volume-wise. but do not cost more than 10%.
- Can be monitored monthy or bi-monthly basis.

Category	Value (%)	Volume (%)	Desired degree of control
A	70	10	Strict
B	20	20	moderate
C	10	70	low.