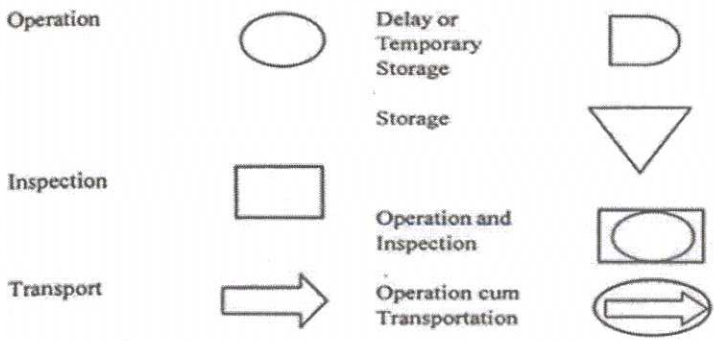
SCHEME OF VALUATION

(Scoring Indicators)

Revision: 2015 Course Code: **5022**

Course Title: INDUSTRIAL ENGINEERING

Qst. No.	Scoring Indicator	Split up score	Sub Total	Total
I				
1	**Productivity** is the ratio of output to some or all of the resources used to produce the output.	2	2	
2		2x1	2	
3	Degree of excellence or Fitness for the purpose.	2	2	
4	Variable data: Dimension of a part measured; Hardness in Rock well units; Temperature in degree Celsius; Weight in KG etc. — Attribute data: No: of defectives in a sample; Surface finish of a component; Cracks in sheets by welding etc.	2x1	2	
5	The monetary value of an asset decreases over time due to use, wear and tear or obsolescence. This decrease is measured as **depreciation**	2	2	10
II				
1	**Value engineering** is a systematic method to improve the "**value**" of a product or service that the project produces. It is an integral component of project quality. **Value** is defined as containing two components, function and cost: **Value** = Function / Cost.	6	6	
2	1. Planning Principle: The planning process is important: Why, who, what, when, where, and how? As information is collected, the picture becomes clearer and the plan takes shape. 2. Systems Principle: The boxes fit the pallets, the pallets fit the rack, and the pallets fit the workstation. Everything fits. 3. Work Principle: Ask 4 questions: 1. Can the job be eliminated? 2. If you cannot eliminate, can you combine jobs to reduce cost? (use automated systems) 3. If you cannot eliminate, or combine, can you rearrange the operation to reduce costs? (reduce distance) 4. If you cannot eliminate, combine, or rearrange, can you simplify? (automation). Material handling equipment makes cost reduction easier.			

	4. Space Utilization Principle: The better you use the building, the less space you need to buy or rent. 5. Unit Load Principle: A unit load is a load of many parts that move as one. The most common unit load is the pallet. Wooden pallets are the most popular, because the trucking industry trades pallets. 6. Automation Principle: Automatic storage and retrieval systems place material into storage racks automatically and remove them when needed. 7. Standardization Principle: You want to standardize on one (or as few as possible) size, type, and even brand name because training, spare parts inventory, maintenance and operation of this equipment is most cost efficient.	Any 6x1	6	
3	**Therbligs** are 18 kinds of elemental motions, used in the study of motion economy in the workplace. A workplace task is analyzed by recording each of the therblig units for a process, with the results used for optimization of manual labour by eliminating unneeded movements. The word *therblig* was the creation of Frank Bunker Gilbreth and Lillian Moller Gilbreth, American industrial psychologists who invented the field of time and motion study. It is a reversal of the name *Gilbreth*, with 'th' transposed.	6	6	
4	Stop watch time is the basic technique for determining accurate time standards. They are economical for repetitive type of work. Steps in taking the time study are: 1. Select the work to be studied. 2. Obtain and record all the information available about the job, the operator and the working conditions likely to affect the time study work. 3. Breakdown the operation into elements. An element is a instinct part of a specified activity composed of one or more fundamental motions selected for convenience of observation and timing. 4. Measure the time by means of a stop watch taken by the operator to perform each element of the operation. Either continuous method or snap back method of timing could be used. 5. At the same time, assess the operators effective speed of work relative to the observer's concept of 'normal' speed. This is called performance rating. 6. Adjust the observed time by rating factor to obtain normal time for each element Normal Time = Observed time × Rating ÷ 100 7. Add the suitable allowances to compensate for fatigue, personal needs, contingencies, etc. to give standard time for each element. 8. Compute allowed time for the entire job by adding elemental standard times considering frequency of occurrence of each element. 9. Make a detailed job description describing the method for which the standard time is established. 10. Test and review standards wherever necessary.	6	6	

5

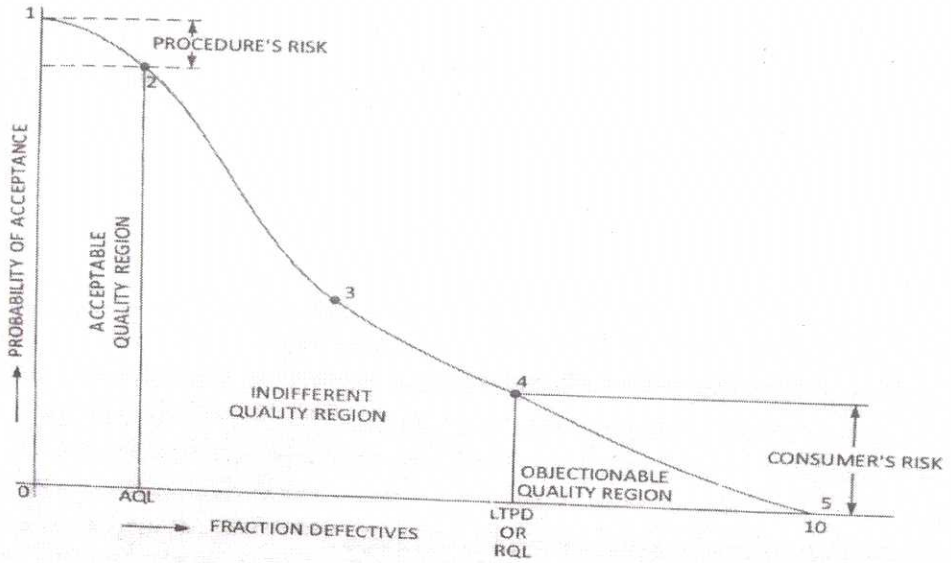
1. Improvement of quality
2. Reduction of scrap and rework
3. Efficient use of men and machines
4. Economy in use of materials
5. Removing production bottle-necks
6. Decreased inspection costs
7. Reduction in cost per unit
8. Scientific evaluation of quality and production
9. Quality caution at all levels
10. Reduction in customer complaints
11. To decide about the standard of quality of a product that is easily acceptable to the customer
12. To check the variation during manufacturing
13. To prevent the poor quality product reaching to customer

6x1 | 6

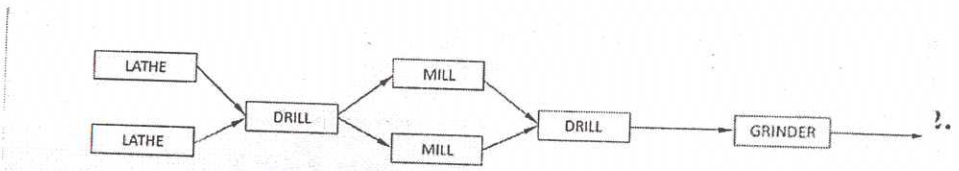
6

S.No.	Floor Inspection	S.No.	Centralized Inspection
1.	The parts are inspected on the production floor it self.	1.	The inspection is carried out in special rooms or cabins.
2.	Job handling time is minimum.	2.	The material handling time is more and costly.
3.	Production control work is less.	3.	Production control work is increased as the parts are to be routed through inspection rooms.
4.	Heavy parts can be inspected in the shop floor.	4.	Not suitable for inspection heavy parts.
5.	Mass inspection is not possible.	5.	Mass inspection is possible with the help of the automatic inspection devices.
6.	Inspector may be influenced by some	6.	Not possible for favoritism.
7.	Accidents may occur due to piling of materials at work place.	7.	Possibility of occurrence of accidents is rare.
8.	Rejections are less.	8.	Rejections are more.
9.	Highly skilled inspectors are to be employed.	9.	Less skilled inspectors may be utilized.
10.	Keeping an account of good or bad pieces is difficult.	10.	It is possible to maintain an account of good or bad pieces.

6x1 | 6

7	An operating characteristic (**OC**) curve is a chart that displays the probability of acceptance versus percentage of defective items (or lots).  To construct OC curve the values of Pa corresponding to varying fraction defectives are required. These values can be obtained from the table of poison's distribution which are given in this book. The OC curve is shown above It can be divided in to three Zones. 1. Acceptable quality region. 2. In-different quality region. 3. Objectionable quality region. The OC curve passes through 5 important points. 1. $P_a = 100\%$ 2. A Q L 3. $P_a = 50\%$ 4. L T P D 5. $P_a = 0\%$	3 3	 6	 30

III a)	1. **Job production:** This type of production is most commonly observed when you produce one single unit of a product. 2. **Batch production:** It is one of the types of production most commonly used in consumer durables, or other such industries where there are large variety of products with variable demands. Batch production takes place in batches. The manufacturer already knows the number of units he needs to a manufacturer and they are manufactured in one batch. Features of Batch production • Production is done in batches • The total number of units required is decided before the batch production starts • Once a batch production starts, stopping it midway may cost a huge amount to the company. • Demand plays a major role in a batch production. Example – seasonality of products. 3. **Mass and flow production:** Mass production is also known as flow production or assembly line production. It is one of the most common types of products used in the automobile industry and is also used in industries where continuous production is required. **Features of Mass Production** • Mass production is generally used to dole out huge volumes of the product • It is used only if the product is standardized • Demand does not play a major role in a Mass production. However, production capacity determines the success of a mass production. • Mass production requires huge initial investment and the working capital demand is huge too. 4. **One time large production:** Difference between job production and one time large production is of scale and complexity of the product. Example fabrication of ships, space vehicles, aircrafts etc.	4x2	8	
b)	1. **Preventive Maintenance (planned maintenance):** follows the principle of that "prevention is better than cure". In this the steps are taken to prevent breakdowns before it occur and thus reduce consequent loss to the company. 2. **Predictive Maintenance:** In this method we can predict the future failure and carryout proper preventive measures. Instruments used for prediction are audio gauges,			

	vibration analyzers, pollution testers, temperature gauges etc. The cost of PrM is less than PM. **3.Breakdown maintenance(corrective maintenance):** In this repairs are carried out after the equipment goes out of order and unable to perform its normal function.BM is used in small factories, where down time repair cost are less compared to any other type of maintenance. **4. Scheduled maintenance:** SM is done according to the recommendations of the supplier of the equipment's. E.g. automobile servicing and oil change, cleaning of water tanks, cleaning of boiler shells etc. SM is a "stitch in time" procedure aimed at avoiding breakdowns. **5. Condition based maintenance:** CM is done only if some conditions are said to occur. E.g. temperature or pressure of a system exceeds the permitted limit, an alarm may ring.	7	7	15
IV a)	Plant layouts **1) Product layout:** In this type of layout the machines and equipment's are arranged in one line depending upon the sequence of operations required for the product. **Advantages of Product layout:** • Low cost of material handling, due to straight and short route and absence of backtracking • Smooth and continuous operations • Continuous flow of work • Lesser inventory and work in progress • Optimum use of floor space • Simple and effective inspection of work and simplified production control • Lower manufacturing cost per unit **Disadvantages of Product layout:** • Higher initial capital investment in special purpose machine (SPM) • High overhead charges • Breakdown of one machine will disturb the production process. • Lesser flexibility of physical resources.  **2) Process layout:** In this type of layout the machines of a similar type are arranged together at one place. This type of layout is used for batch production. It is preferred when the product is not standardized and the quantity produced is very small.	4		

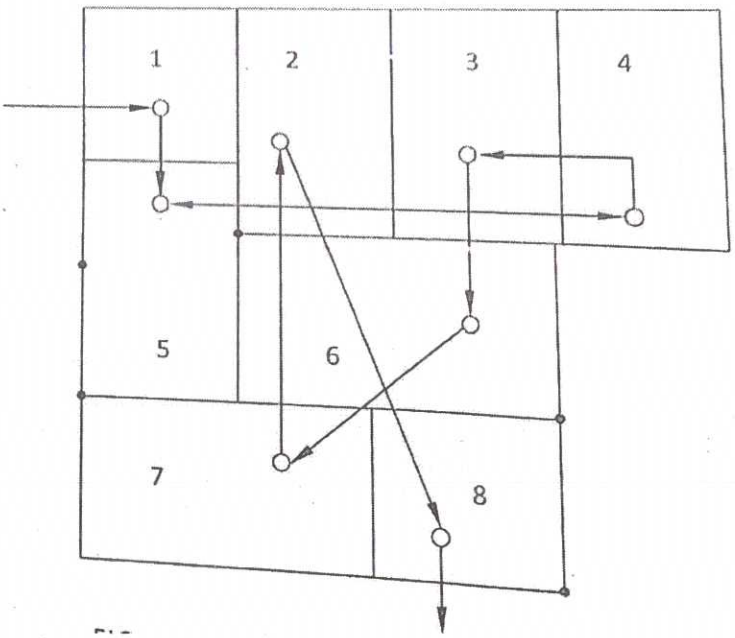
Advantages of Process layout:

- Lower initial capital investment is required.
- There is high degree of machine utilization, as a machine is not blocked for a single product
- The overhead costs are relatively low
- Breakdown of one machine does not disturb the production process.
- Supervision can be more effective and specialized.
- Greater flexibility of resources.

4

Disadvantages of Process layout:

- Material handling costs are high due to backtracking
- More skilled labour is required resulting in higher cost.
- Work in progress inventory is high needing greater storage space
- More frequent inspection is needed which results in costly supervision



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b) **Engineering factors:**

1)Building construction **2)** Lay out **3)** Production process and equipment's **4)** Production planning and control **5)** Nature of materials and products to be handled **6)**Packaging etc.

7x1 | 7

Economic factors:

	Cost of material handling equipment's, operating costs, repair costs, taxes, insurances, depreciation costs etc.			15	
V					
a)	**SIMO CHART (Simultaneous Motion Cycle chart):** It is an extremely detailed left and right hand operation chart. It shows the therbligs performed by the two hands as well as other limbs of an operator .Here the time scale is marked in **Winks** (1/2000 of a minute). A sample SIMO chart is shown below.	4			
	Department ..... Operation : Finish hand filling Date ..... Film No..... Charted By ..... Operator				
				8	
b)	1. To determine working time and idle time of men and machines. 2. To time long duration activities. 3. To estimate allowances for unavoidable delay. 4. To set time standards. 5. It can be applied in stores, hospitals, ware houses, offices, farm work repairs, textile industries, machine shop etc. 6. It is preferred when the cost of using other work measurement techniques are high. 7. To estimate the percentage utility of indirect labour. 8. It can be used for the purpose of cost control and accounting.	7x1	7	15	

S.No.	Left hand description	Therblig	Time	Therblig	Right hand
1.	Searching and lifting workpiece.	SH. H	400		
2.			400	U	Opening the vice
3.	Clamping workpiece in vice	PP	800	PP	Clamping work-piece in the vice
4.	Search and lift file	SH. H	400	TL	Take the file.
5.	Do the hand filling operation.	U	2000	U	Do the hand filling Operation.
6.			400	TL	Taking the micrometer
7.	Check the dimension	I	1600	I	Check the dimension
8.			400	U	Open the vice
9.	Remove the workpiece	TL	400		

VI a)	a) principles related to use of ***human body*** • Both hands should be used for productive work. • Both the hands start and finish their motions at same time. • The two hands should not be idle at the same time except during periods of rest. • Motions of the arms should be symmetrical and in opposite directions • Motion should be smooth and continuous. • Work should be arranged so that eye movements are confined to a comfortable area, without the need for frequent changes of focus. • Continuous curved movements are to be preferred to straight-line motions involving sudden and sharp changes in direction. b) principles related to the ***workplace arrangements*** ✓ *Fixed locations should be provided for all tools and materials so as to permit the best sequence and* ***eliminate search and select*** ✓ *Gravity bins and drop delivery should be used to* ***reduce reach and move times*** ✓ *Use may be made of* ***ejectors for removing*** *finished parts* ✓ ***Work table height*** *should permit work by the operator in alternately sitting and standing posture* ✓ *Glare-free* ***adequate illumination****, proper* ***ventilation*** *and proper* ***temperature*** *should be provided*	4x1 4x1	8	
b)	Normal time= Machinery time + Manual time X Rating factor = 5+ 4 x 1.15 = 9.6 minutes Standard time = Normal time+ Allowances = 9.6 + 9.6 x (10/100) = 10.56 minutes	3.5 3.5	7	15

VII a)

Sample	R
A	2
B	7
C	3
D	6
E	6
	$\Sigma R = 24$

$$\bar{R} = \frac{\Sigma R}{n_1} = \frac{24}{5} = 4.8$$

For R chart

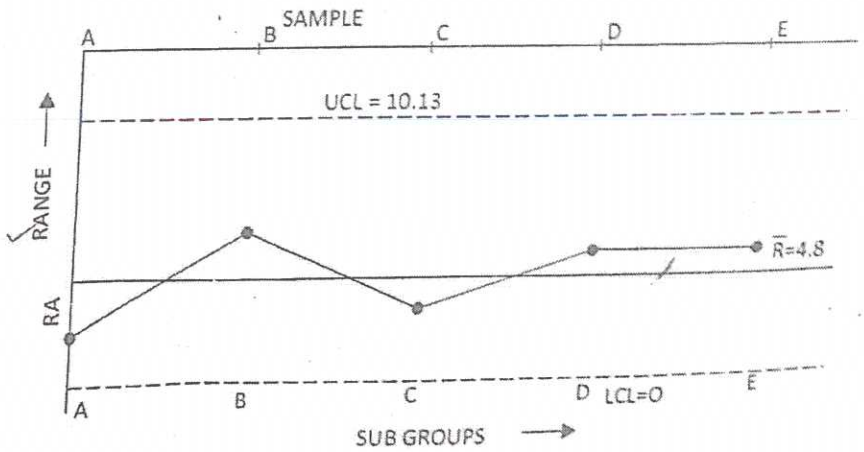
$UCL = D_4\bar{R}$ and $LCL = D_3\bar{R}$

$UCL = 2.11 \times 4.8 = 10.13$ 4

$LCL = 0 \times 4.8 = 0$

From tables for sample size 5

$D_4 = 2.11 \quad D_3 = 0$



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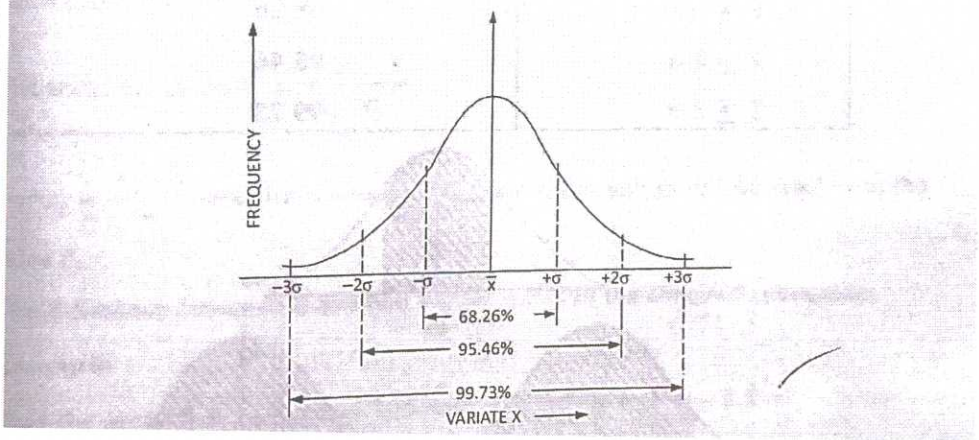
b)	The normal curve is also called probability curve, Gaussian curve or Laplacian curve. It observes normal law. This represents frequency distribution when the observations are large in number. Normal distribution is common in nature. Heights of people, marks obtained by students, intelligence of people are some of the examples of Normal distribution. Histogram represents frequency distribution. Normal curve can be obtained from Histogram if number of observations are more. If the number of observations are increased then the number of cells will increase and the width of the cell will become smaller and smaller. Then the line joining the tops of the cells of Histogram will then approach smooth curve. The height of the curve at any point is proportional to the frequency at that point and the area under it between any two limits is proportional to the frequency of occurrences with in these limits. Such a curve is called 'frequency curve'. The frequency curves may be of different shapes. The most important of these curves in statistical quality control is the normal curve. Its shape is like that of a bell symmetrical about y axis and extends from minus infinity to plus infinity.  	3		
VII I a)	**Mean:** The average of a set of numerical values, as calculated by adding them together and dividing by the number of terms in the set. Mean = $\frac{\Sigma X}{n}$ or Mean = $\frac{\Sigma fX}{n}$ X=sample value, n=sample size, f=sample frequency **Median:** denoting or relating to a value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it. The **median** of a set of data is the middlemost number in the set. To find the median, the data should first be arranged in order from least to greatest. If 'n' observations, then median is $\frac{n+1}{2}$ for odd n values and median is average of $\frac{n}{2}$ th and $[\frac{n}{2}+1]$ th value for even n values. **Mode:** The number which appears most often in a set of numbers. Example: in {6, 3, 9, 6, 6, 5, 9, 3} the Mode is 6. **Standard deviation:** A quantity expressing by how much the members of a group differ from the mean value for the group. The symbol for Standard Deviation is **σ** (the Greek letter sigma).	4 4x2	7 8	15

$$\sigma = \frac{\sqrt{\Sigma(x-\bar{x})^2}}{n}$$

$\bar{x}$ = Mean value.

$x - \bar{x}$ = Deviation of an individual value of 'x' from mean $\bar{x}$.

n = No: of observations.

b) **Calculation of Control Limits on C-Chart :**

$\bar{C}$ is the mean of the defects counted in several such units. The central line of the control chart for C is $\bar{C}$.

$$\bar{C} = \frac{\text{Number of defects in all Samples}}{\text{Total number of Samples}}$$

3 – Sigma control limits are

U.C.L (Upper Control Limit) $= \bar{C} + 3\sqrt{\bar{C}}$

L.C.L (Lower Control Limit) $= \bar{C} - 3\sqrt{\bar{C}}$

The formula is based on normal curve opproximates to the poisson distribution. The use of C-chart is appropriate if the opportunities for a defect in each production unit are infinite but occurance of a defect at any point is very small and is constant. The C-chart technique helps to keep these defects per unit at the lowest level.

7 | 7 | 15

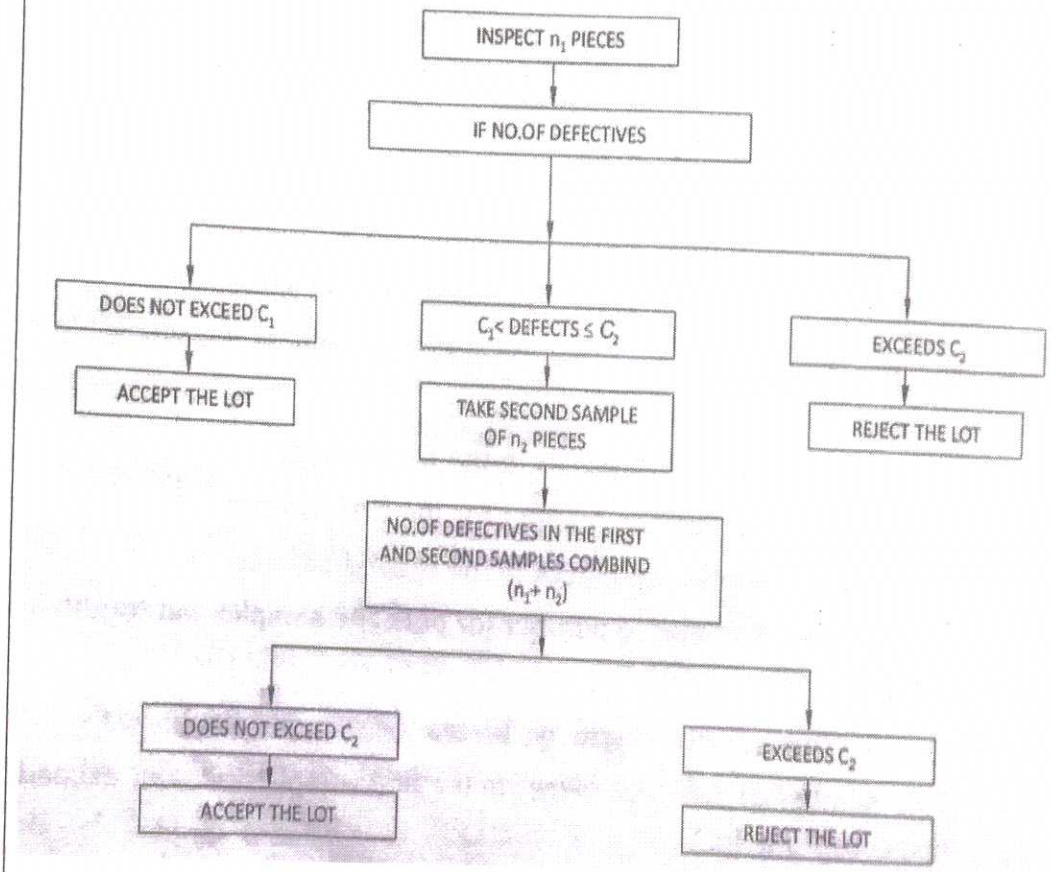
IX

a)

S. No.	Estimating	Costing
1.	It is the calculation of expected cost of the product before manufacturing starts.	1. It is the determination of actual cost of product by adding all the expenses incurred.
2.	Estimator should be an Engineer who possess high technical knowledge. This work is of technical nature.	2. Cost accounting is usually done by a person qualified for Accounts. The work is of clerical nature
3.	It forecasts probable cost and helps to determine whether the manufacturing is profitable or not in advance.	3. It helps manufacturer to know whether the organisation is running in profits or loss.
4.	It helps to fix up market price for proposed production.	4. It helps for budget preparation.
5.	To arrive at a standard probable expenditure for comparison with actual costs after making the product.	5. It facilitates comparison with estimates to know whether the estimates are over, under or realistic. Also helps to identify the un necessary wastage of men, materials, machines money and to keep control over them.

4x2 | 8

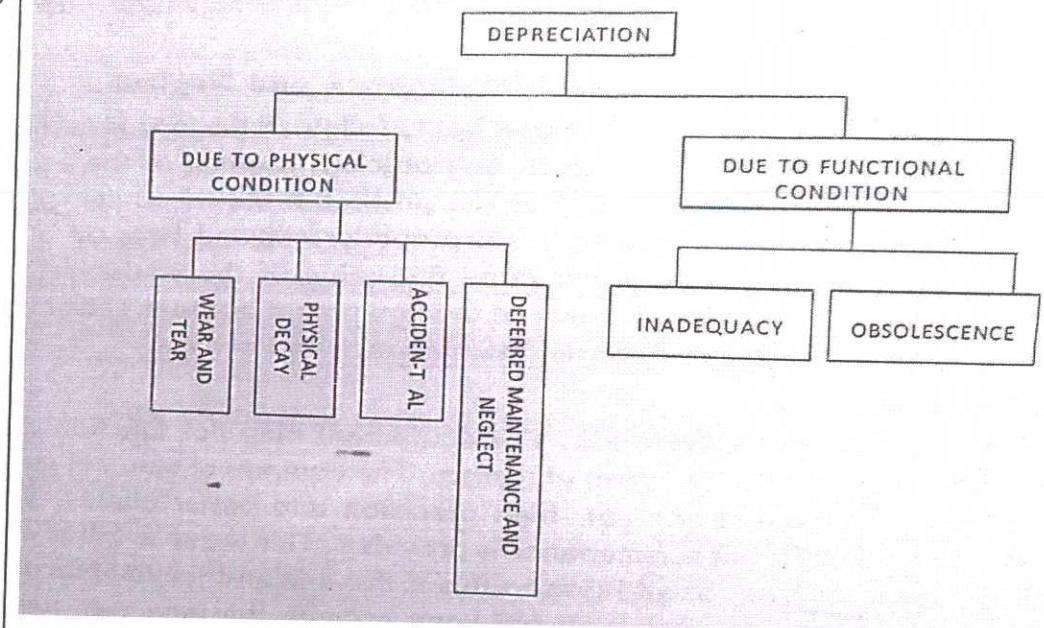
b) **Double sampling plan**



7 7

X

a) **Causes of Depreciation :**



3

15

	1.Annual rate of depreciation (D) = (P-S) / N = (40000- 6000) / 10 = 3400 2.Depreciation fund collected at the end of 5 years = 3400x 5=17000	2.5 2.5	8	
b)	Estimating procedure 1. *Specifications of product* : Production planning department decides the requirements and specifications of the product. 2. *Preparation of drawings* : Production planning department makes the drawings, lays down the method and sequence of operations, machines to be used, rates allowed to the labour in consultation with the Time and motion study department and wage department. 3. *Parts list* : Prepare the list of all the parts or components of the product. 4. *Manufacture or Buy* : Decide which components should be manufactured in the factory it self and which components should be procured from the market. 5. *Material cost* : Calculate the Quantity of various types of materials required for the product and determine the total material cost. 6. *Machining or processing data* : Determine the cutting speeds, feeds for that particular materials. 7. *Machining allowances* : Add material handling time, tool set up time, tear down time and other allowances to machining time to arrive at total time. 8. *Labour cost* : Then calculate the labour cost by multiplying the total time taken to complete the job considering the wage rates allowed for various categories of workers employed. 9. *Prime cost* : Determine the prime cost after adding direct expenses to the direct material and direct labour costs. 10. *Over head charges and total cost* : Determine the factory over heads including depreciation and expenditure on maintenance of the plant, insurance, power etc., and add them to prime cost to calculate total cost. 11. *Sale price* : Decide the suitable profits and add to the total cost in order to fix up the sale price. 12. *Discount and market price* : Decide the reasonable discount to be allowed to the distributor and add this to sale price to get market price or catalogue price. 13. *To management for approval* : Supply this data to the Management for approval and to fix up the above calculated market price.	7	7	15