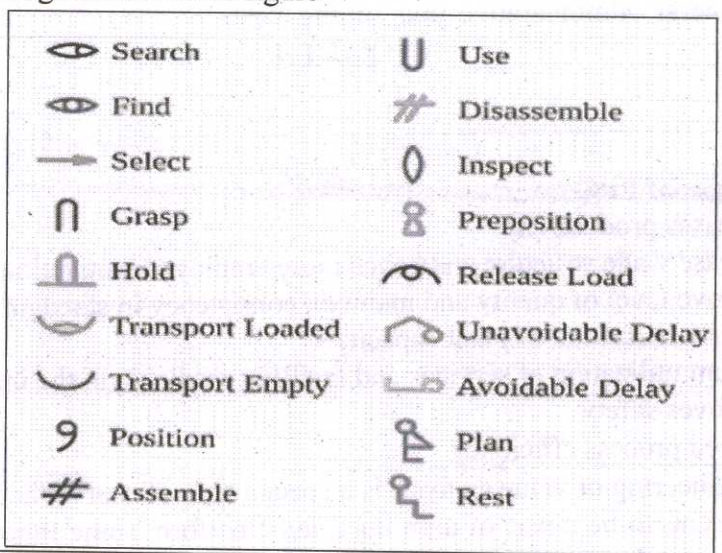
SCHEME OF VALUATION
(Scoring Indicators)

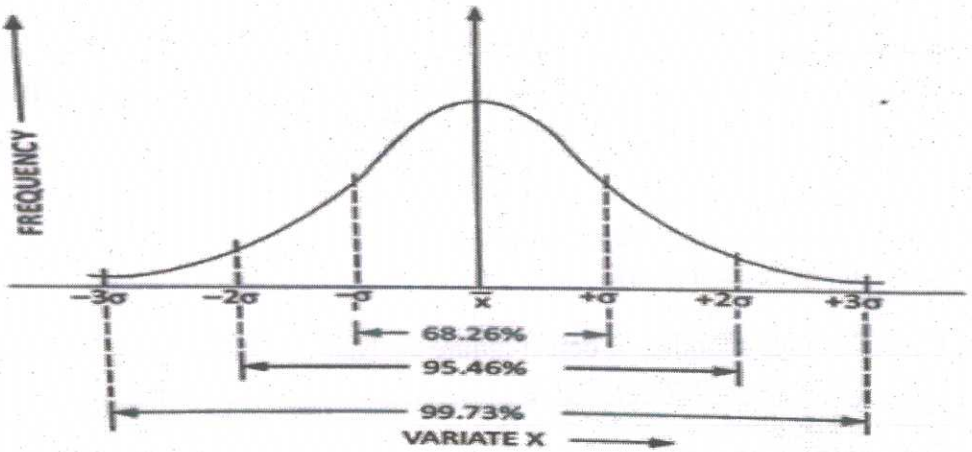
Revision: 2015 **Course Code: 5022**

Course Title: Industrial Engineering

Qst. No	Scoring Indicator	Split up score	Sub Total	Total
	PART A			
I 1	Productivity is regarded as efficiency in industrial system.it is the ratio between outputs to input Productivity = Output / Input	2	2	2
2	It is the total time in which a job should be completed at standard performance. It is the sum of normal time (basic time) and allowances. Policy allowance is not included.	2	2	2
3	Quality is conformance to requirement or specifications. Quality is defined as the fitness for use.	2	2	2
4	It represents the reduction in market value of an asset due to age, wear and tear and obsolescence.	2	2	2
5	Cost estimating may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into consideration all expenditures involved in design and manufacturing with all the related service facilities such as pattern making tool making, as well as a portion of the general administrative and selling costs.	2	2	2
	PART B			
II 1	**Advantages of PPC** ➢ It increases productivity ➢ It increase wage structure and hence more employee motivation ➢ It improve level of quality and maintain consistency in standard ➢ Optimum utilization of plant capacity ➢ Optimum utilization of services and facilities available in the industry ➢ It improves safety ➢ Improved process efficiency	1 X 6	6	6
2	Value engineering or value analysis is a special type of cost reduction technique. A component, to be a part of a product, must perform some function and serve some purpose. Value analysis examines the design, function and cost of each and every component in order to produce it economically without decreasing its utility, function and reliability. A simple example of tooth paste tube or talcum powder container may be taken for illustrating the concept of value analysis.	6	6	6

	The function of collapsible tube of tooth paste or container of talcum powder is only to contain the product. Earlier they were made of sheet metal or aluminum which is costly. They are now a days being replaced by plastic tube to contain tooth paste and hard board containers to contain talcum powder.			
3	**Steps to develop standard data** 1. Collect all the possible details about the job. For example, material, dimensions, method, conditions etc. The collected details should be reliable 2. Break the job into constituent into elements. The operations are broken into a number of elements. Many operators in an industry have several common elements. Example: starting the machine, stopping the machine etc. Whenever these activities occur, they take the same duration of time. These elements are called constant elements. Time for some elements vary proportionately with the speed, feed, length of out etc. In machining operation. These elements are known as variable elements. Variable elements and constant elements are separated. 3. Collect the elemental time for constant elements from the standard data bank. 4. For variable elements, the elemental time can be found out by using the charts and graphs. 5. As far as possible, select the approximate normal times for all the elements involved in the operation, from the synthetic data or the standard data. 6. Estimate the various allowances like, personal and rest allowances, process allowances and special allowances for each element 7. Verify the analysis of elements for selected job method and other conditions 8. Add various allowances to the normal time for each element and sum up all such times for fix the standard time for new job	6	6	6
4	THERBLIGS are used to describe the basic elements of movements or fundamental hand and other limb motions of the work cycle. Every THERBLIG (Gilberth spelt backward) is represented by a symbol, a definite colour and a word or two to record the same. For example, THERBLIG Grasp has symbol Ω, red colour and is denoted by G. Various therbligs are shown in figure  	3 3	6	6
5	**Quality Cost** Quality cost means cost of poor quality goods and services. Following are the main quality associated costs ➢ **Failure Costs**			

	➢ **Appraisal Costs** ➢ **Prevention Costs** **Failure Costs** It includes internal cost arise due to internal failures and external failure cost arise from the rejection of products services by the customers due to poor quality **Internal Failure Costs** Costs associated with scrap and rejects Costs of repair and rework Cost of design changes Cost of trouble shooting or defect failure analysis Cost of reinspection and retesting Cost of downtime **External failure costs** Cost of processing complaints from customers Cost of replacing the defective items Cost of guarantee and warranty claims Cost of lost goodwill of customer Cost of loss of future sales **Appraisal Costs** Appraisal costs relate to testing, execution and examination to assess whether specified quality is being maintained. It includes Cost of receiving test and inspection Cost of equipment calibration and maintenance Cost of test equipment and commissioning Cost of evaluation of customer satisfaction Cost of analysis of reporting of tests and inspection results **Prevention Costs** Prevention costs are the costs that are incurred on preventing a quality problem from arising. It includes Cost of quality planning Cost of documenting Cost of training Cost of quality awareness programme Cost of review of new products	2 2 2	6	6
6	**Normal Curve** The normal curve is also called probability curve, Gauusian curve or Laplacian curve. It observes normal law. This represents frequency distribution when the observations are large in number. Its shape is like that a bell symmetrical about Y axis and extends from minus infinity to plus infinity. The area under the curve is very useful in SQC to determine whether the manufacturing process is within control or not. Area under this curve depicts normal distribution of variation pattern. Theoretically Normal curve extends from $-\infty$ to $+\infty$. But for practical purpose we can consider normal curve as extending only 3 to the left and 3 values to the right of the mean $X + \sigma$.	3	6	6



Specification Limits	Percent of total area under the curve with in specified limits
$\bar{x} \pm 0.6745\,\sigma$	50
$\bar{x} \pm \sigma$	68.26
$\bar{x} \pm 2\,\sigma$	95.46
$\bar{x} \pm 3\,\sigma$	99.73

3

7

	Estimating
1.	Estimation is the calculation of factory cost of a product before it is actually produced
2.	Estimating requires technical knowledge
3.	Estimating is a pre operation of production
4.	It helps to fix up market price for proposed production
5.	Estimating indicates whether it would be profitable to manufacture a product or buy from outside
	Costing
1	Costing is the actual cost the product is manufactured.
2.	Costing requires only clerical work of accounts
3.	Costing is a post operation of production
4.	It helps for budget preparation
5.	Costing helps to know the profitability of product after its production.

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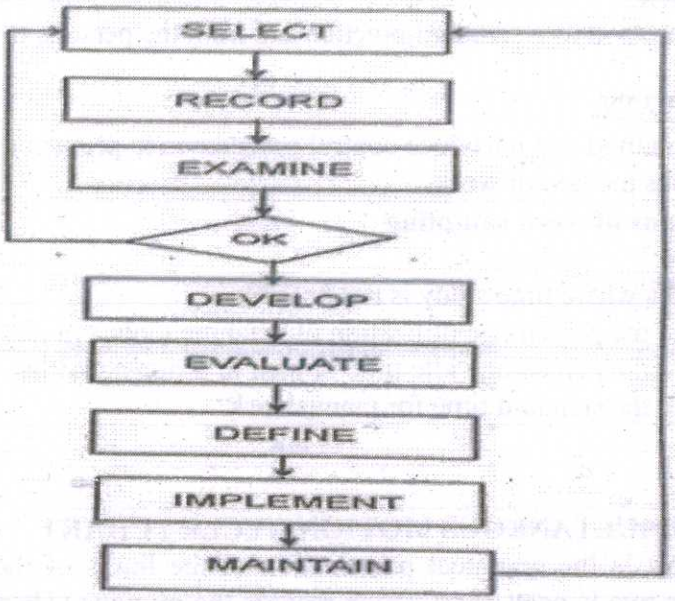
	PART C			
III				
a	**Plant Layout** Plant layout refers to the arrangement of the physical facilities including work centers for the manufacturing of a product. It is the spatial arrangement of the physical resources used to produce a product. **Objectives of Plant Layout** 1. To facilitate production process 2. To Minimise material handling 3. To maintain flexibility in the operations 4. To economically use all floor space 5. To provide optimum utilization of machines and equipment 6. To reduce risk hazards 7. To bring about higher productivity **TYPES OF PLANT LAYOUT** 1. Fixed position layout 2. Product layout (Line Layout) 3. Process layout (Functional Layout) 4. Combination layout	2 3 3	8	8
b	**ROUTING** Routing may be defined as the selection of path which each part of the product will follow while being transformed from raw materials to finished products. Path of the product will also give sequence of operation to be adopted while being manufactured. In other way, routing means determination of most advantageous path to be followed from department to department and machine to machine till raw material gets its final shape **Routing procedure** 1. The finished product is analysed and broken into number of components required for the product 2. Bills of material are prepared from the parts list and decide what is to be produced in the plant and what is to be purchased from outside 3. Available machine capacities and machine characteristics are find out 4. Necessary operation through which raw materials has to undergone are listed 5. Path of material is decided. 6. Prepare a route sheet 7. The economic lot size is determined 8. Determine the scrap factors and places where scrap is very likely to occur are identified. The cost of each production of each component is estimated.	3 4	7	7
	OR			
IV				
a	**TYPES OF MAINTENANCE** Maintenance may be classified into following categories 1. Preventive maintenance 2. Predictive maintenance 3. Breakdown or Corrective maintenance 4. Scheduled maintenance, **Preventive Maintenance** It is also called planned maintenance or systematic plant maintenance. It locates	2	8	8

	weak spots (such as bearing surfaces, parts under excessive vibrations, etc.) in all equipment, provides them regular inspection and minor repairs thereby reducing the danger of unanticipated breakdown. The underlying principle of preventive maintenance is that "Prevention is better than Cure". Preventive maintenance is a means to increase the reliability of their equipment. **Predictive Maintenance** This is a modern concept having excellent future prospects. It makes use of human senses or other sensitive instruments such as Audio gauges, Vibration analyzers, Amplitude meters, Pressure, temperature and resistance strain gauges, etc., to predict troubles before the equipment fails. Unusual sounds coming out of rotating equipment predict an upcoming trouble, an electric cable excessively hot at one point predicts a trouble. These can be sensed observed and detected at right time and necessary repairs and faulty parts are replaced. In predictive maintenance, equipment conditions are measured periodically or on a continuous basis and this enable maintenance men to take a timely action such as equipment adjustments, repair or overhaul. Predictive maintenance extends the service life of equipment without fear of failure. **Breakdown or Corrective Maintenance** Breakdown maintenance is basically the 'run it till it breaks' maintenance mode. The repairs are made after the equipment is out of order and it cannot perform its normal function any longer, e.g., an electric motor will not start, a belt is broken, etc. Under such conditions, production department calls on the maintenance department to rectify the defect. The maintenance department checks into the difficulty and makes the necessary repairs. After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs. **Scheduled Maintenance** Scheduled maintenance is conducted by a predetermined and pre planned schedule. Normally this is done according to the recommendations of supplier of the equipment. For example, 2 wheeler suppliers gives the time table or schedule to change the oil, to check the lubrication system, ignition system, battery maintenance etc. Scheduled maintenance practice incorporates inspection, lubrication, repair and over-haul of certain equipment which if neglected can result in breakdown. Inspection, lubrication, and servicing of this equipment are included in the predetermined schedule. Scheduled maintenance practice is generally followed for overhauling of machines, cleaning of water and other tanks, white-washing of buildings, etc.	2 2 2		
b	**Methods of increasing the productivity** ✓ by increasing the output for a given input ✓ by right utilization of human resources through motivation and training ✓ by reducing scrap to the maximum extent ✓ by adopting preventive maintenance measures ✓ by using correct tooling and equipment ✓ by providing good working conditions ✓ by adopting latest technology such as automation, robotics etc ✓ by promoting Research and development activities ✓ by providing Incentive schemes	7 X 1 = 7	7	7

V				
a	**Procedure involved in Method Study**  **1. SELECT** The job or process to be studied which is primarily based on ➢ Economic considerations ➢ Technical considerations ➢ Human considerations. The main objective of this is to reduce manufacturing cost **2. RECORD** AII the relevant information related to existing method in detail should be recorded. Recording can be done with following methods. **(a) Process charts** i. Process Out line process chart. ii. Flow process chart; Man type, Material type and Equipment type iii. Two handed process chart. iv. Multiple activity charts. **(b) Diagrams** i) Flow diagrams ii) String diagrams iii) Cycle graph iv) Chronocycle graph (c) Micromotion study **3. EXAMINE** The purpose, place and sequence of every operation should be critically examined. This help will reveal defects in existing methods **4. DEVELOP** The most practical, economic and effective method, drawing on the contributions of those concerned **5. EVALUATE** Different alternatives to developing a new improved method comparing the cost effectiveness of the selected new method with the current method with the current method of performance. **6. DEFINE**	4 4	8	8

	The new method, as a result, in a clear manner and present it to those concerned, i.e. management, supervisors and workers. **7. INSTALL** The new method as a standard practice and train the persons involved in applying it. **8. MAINTAIN** The new method and introduce control procedures to prevent a drifting back to the previous method of work.			
b	**Applications of work sampling** 1. Long cycle operations. 2. Activities where time study is not possible. 3. Estimate the percentage utilization of machine tools, cranes, trucks etc. 4. Estimate the percentage idle time of men in group activities. 5. Estimate the standard time for manual task.	7	7	7
	OR			
VI				
a	**SIMO (SIMULTANEOUS MOTION CYCLE) CHART** SIMO chart is the graphical presentation of the limbs of the workman under study. lt is two handed chart which records the motions (Therbligs) of both the hands on a common scale. A few motions of other limbs such as of eye and body are also on this Chart. Fig. shows a typical SIMO chart.	4	8	8
	SIMO CHART Operation ..... Date ..... Name of worker ..... Film No. ..... Component, Name..... Operation No. ..... Method : present / proposed **Left hand description** | **Symbol** | **Time (Winks)** | **Symbol** | **Right hand desctiption** To bolt | TE ◡ | 20 | TE ◡ | To nut Grasp bolt | G ∩ | 5 | G ∩ | Grasp Nut To job | TL ∽ | 10 | TL ∽ | To job Hold | H ⊥ | 50 | A ⋕ | Assemble to bolt	2		
	Advantages 1. lt is useful technique for very short cycle job 2. lt is a permanent record of motions performed by a worker which can be made without disturbing the worker. 3. lt can be used for training purpose.	2		
b	**Procedure for conducting stop watch time study.** The following procedure is followed in conducting stop watch time study: **1. Selecting the job.** Time study is always done after method study. Under the following situations, a	7		

	job is selected for time study: A new job, new component or a new operation, when new time standard is required, to check the correctness of the existing time standard, when the cost of operation is found to be high, before introducing an incentive scheme etc. **2. Recording the specifications.** Information about the product name, product-number, specification, machine, equipment and tools, working condition -temperature-humidity-Lighting, operator name-experience-age etc. **3. Breaking operation into elements** Each operation is divided into a number of elements. This is done for easy observation and accurate measurement. The elements are grouped as constant element, variable element, occasional element, man element, machine element etc. **4. Examining each element.** The elements are examined to find out whether they are effective or wasteful. Elements are also examined whether they are done in the correct method. 5. **Measuring using Stop watch** The time taken for each element is measured using a stop watch. There are two methods of measuring. viz., Fly back method and Cumulative method. The time measured from the stop watch is known as observed time. Time for various groups of elements should be recorded separately. This measurement has to be done for a number of times. The number of observations depend upon the type of operation, the accuracy required and time for one cycle. **6. Assessing the rating factor.** Rating is the measure of efficiency of a worker. The operator's rating is found out by comparing his speed of work with standard performance. The rating of an operator is decided by the work study man in consultation with the supervisor. The standard rating is taken as 100.. **7. Calculating the basic time** Basic time is calculated as follows by applying rating factor Basic time = Observed time x Operator rating **8. Determining the allowances.** A worker cannot work all the day continuously. He will require time for rest going for toilet, drinking water etc. Unavoidable delays may occur because of tool breakage etc. So some extra time is added to the basic time. The extra time is known as allowance. 9. **Compiling the standard time** The standard time is the sum of basic time and allowances. The standard time is also known as allowed time.		7	7

VII				
a				

Floor inspection	
1.	The parts are inspected on the production floor itself
2.	Job handling time is minimum
3.	Production control work is less
4.	Heavy parts can be inspected in the shop floor
5.	Inspector may be influenced by someone
6.	Rejection are less
7.	Highly skilled inspectors are to be employed
8.	Mass inspection is not possible
9.	The worker and work may get disturbed
10	Maintenance of inspection record is difficult

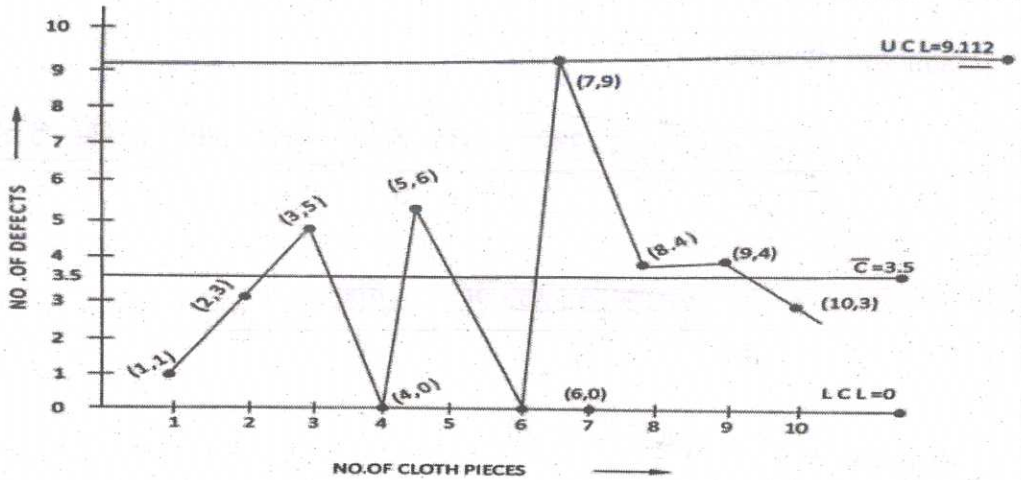
4

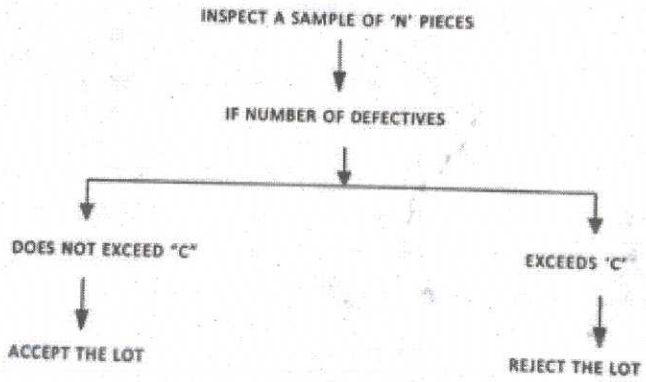
Centralized inspection	
1.	The inspection is carried out in special rooms or cabins
2.	The material handling time is more and costly
3.	Production control work is increased as the parts are to be routed through inspection rooms
4.	Not suitable for inspection heavy parts
5.	Not suitable for favoritism
6.	Rejections are more
7.	Less skilled inspectors may be utilized
8.	Mass inspection is possible with the help of the automatic inspection devices
9.	The operators are not disturbed
10.	Record keeping is easy

4

8 8

b	Arithmetic mean $\bar{x} = \frac{344+338+342+335+336}{5}$ $= \frac{1695}{5} = 339^0$ Arranging in ascending order the values are $335^0, 336^0, 338^0, 342^0$, and 344^0 Median = Central value = 338^0 Range = Largest value – Smallest value = 344 – 335 = 9 Standard deviation σ = $\sqrt{\frac{(335-339)^2 (336-339)^2 + (338-339)^2 + (342-349)^2 + (344-339)^2}{5}}$ $= \frac{\sqrt{16+9+1+49+25}}{5} = \frac{\sqrt{100}}{3} = 4.475$ Variance = $\sigma^2 = (4.475)^2 = 20.$	1 1 1 1 1 Step.= 2	7	7
	OR			
VIII				
a	Procedures to construct $\bar{X}$-chart and R-chart 1. Identify the process to be controlled 2. Select the variable of interest. 3. Decide a suitable sample size (n) and number of samples to be collected (k). 4. Collect the specified number of samples over a given time interval. 5. Find the measurement of interest for each piece within the sample. 6. Obtain mean ($\bar{X}$) of each sample. 7. Establish control limits for $\bar{X}$ and R-charts. **For $\bar{X}$-Chart**	4	8	8

	Upper Control Limit, $UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \bar{R}$ **Lower Control Limit,** $LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \bar{R}$ $\bar{X}$ **and** $\bar{R}$ **are also called centre line values.** **For** R **chart :** $UCL_R = D_4 \bar{R}$ $LCL_R = D_3 \bar{R}$	1 1 1 1		
b	$\bar{C} = \frac{1+3+5+0+6+9+4+4+3}{10} = \frac{35}{10} = 3.5$ $UCL = \bar{C} + 3\sqrt{\bar{C}}$ $= 3.5 + 3\sqrt{3.5}$ $= 3.5 + 5.612 = 9.112$ $LCL = \bar{C} - 3\sqrt{\bar{C}}$ $= 3.5 - 5.612 = -2.112 = 0$ (Since L C L Can't be –ve) Now draw the C-chart using the above values of $\bar{C}$, U C L and L C L and draw the graph and locate the points.  From the above graph it is observed that all the points are laying within the control limits. Therefore the process is in a state of statistical control.	1 1 1 3 1	7	7
IX				
a	Sampling plans may be grouped into three categories as follows. 1. Single sampling plans 2. Double sampling plans 3. Multiple sampling plans **Single Sampling Plans** When the decision on acceptance or rejection of the lot is made on the basis of only one sample, then acceptance plan is known as a single sampling plan	Fig 3 X 1 = 3 + Explanation 5	8	8



Double Sampling Plan

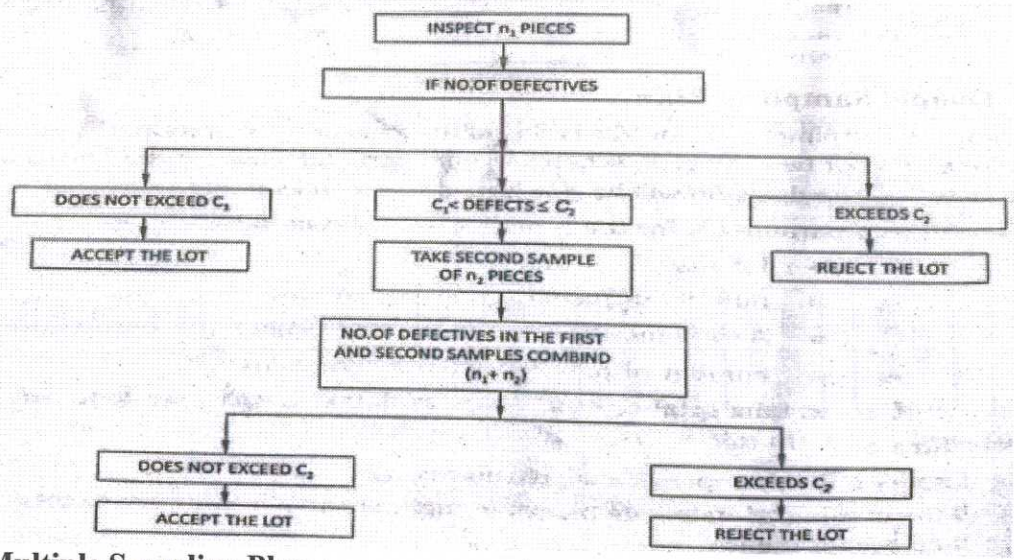
In double sampling plan the decision on acceptance or rejection of the lot is based on two lots. If the selected sample is not accepted, another sample is taken and the two samples are combined. The decision is based on the combined sample.

n_1=number of pieces in the first sample

C_1=maximum number of defectives that will permit the acceptance of the lot on the basis of first sample

n_2=number of pieces in second sample

C_2=maximum number of defective that will permit the acceptance of the lot on the basis of first and second sample combined



Multiple Sampling Plan

In this plan one two, three or more samples may be required to arrive decision regarding acceptance or rejection of a lot. After each sample is inspected decision is taken to accept the lot or reject the lot or take another sample for further inspection. A multiple sampling procedure can be represented on a table shown below.

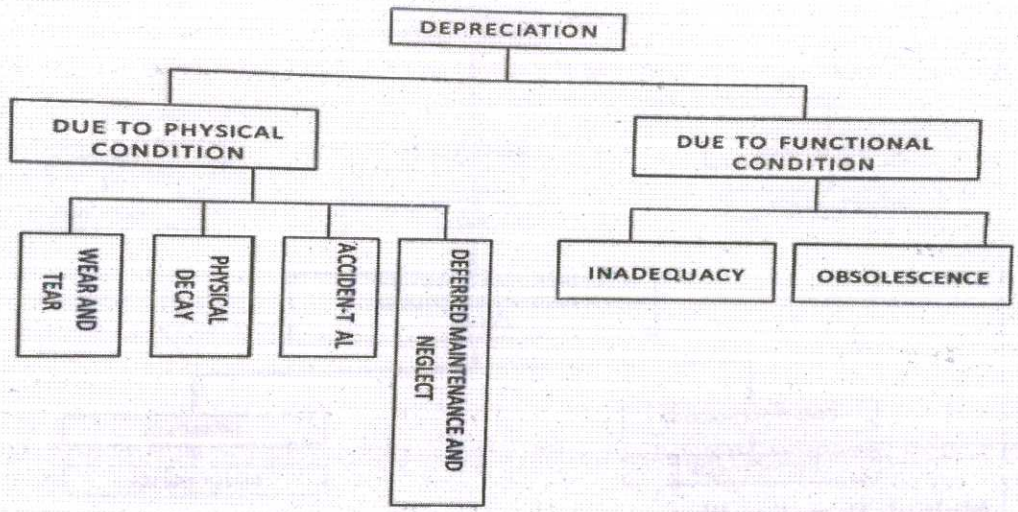
Sample	Sample size	Combined sample size	Acceptance number	rejection number
First	n_1	n_1	c_1	r_1
Second	n_2	$n_1 + n_2$	c_2	r_2
Third	n_3	$n_1 + n_2 + n_3$	c_3	r_3
Fourth	n_4	$n_1 + n_2 + n_3 + n_4$	c_4	r_4
Fifth	n_5	$n_1 + n_2 + n_3 + n_4 + n_5$	c_5	$c_5 + 1$

A first sample n, is drawn. The lot is accepted if the number of defectives is q or less and lot is rejected if the defective items are r, or more. If the defectives are more than c, and less than r, the lot can neither be accepted nor rejected. Now to collect additional information about the lot, second sample 2 is drawn. The procedure is continued in accordance with the above table up to n_5 is drawn. The lot is accepted if the number of defectives in the combined sample of $n_1+n_2+n_3+n_4+n_5$ does not exceed c_5. Otherwise the lot is rejected. Note that $c_1< c_2< c_3< c_4<c_5$ and $c_1<r_1$ for all i.

b

Causes of Depreciation

The causes of depreciation are shown above inline diagram and explained below.



3

7 7

Depreciation Due to Physical Condition Depreciation due to wear and tear

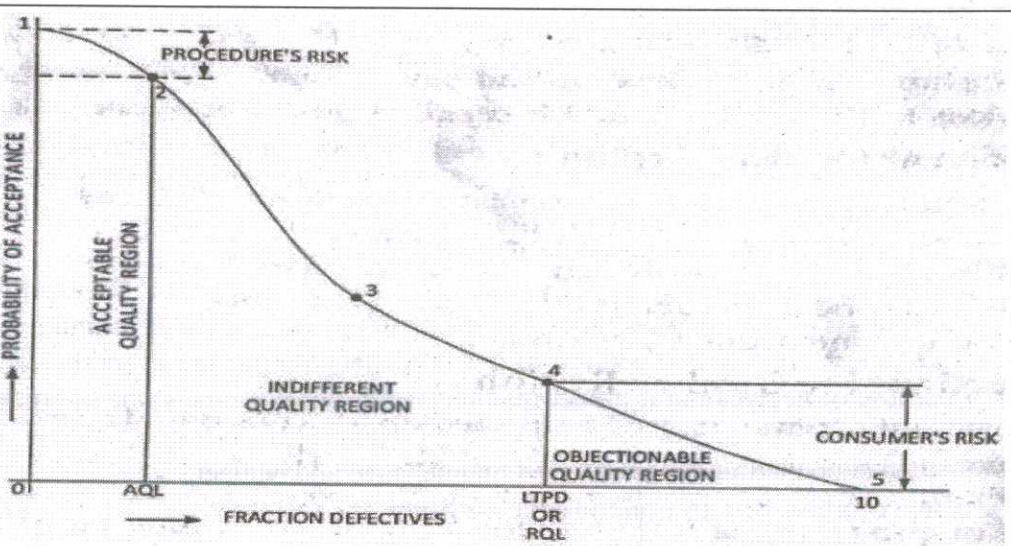
When the machine or equipment performs useful work, the wear and tear is bound to occur. It can be reduced with proper care and regular maintenance using lubricating oils. But it cannot be prevented. The reduction in the value of the equipment due to this reason is called depreciation due to wear and tear.

4

Depreciation due to physical delay

Certain items in a factory like furniture, electric cables, poles, buildings, chemical vessels etc. get delay due to climatic and atmospheric effect and therefore the value of these articles goes on reducing with the lapse of time. Inspite of taking every care to keep them in serviceable condition there will be reduction in their value. The reduction in values is known as depreciation due to physical decay.

	Accidental depreciation The reduction in the value of equipment caused due to accidents is called accidental depreciation. Accident may occur due to some wrong operation or loose component or some other cause which may result in heavy damage. The depreciation in machine caused due to this reason is called accidental depreciation. **Depreciation due to deferred maintenance and neglect** After purchasing the equipment the user has to follow all the instructions supplied by the manufacturer for the smooth and efficient running of the equipment. If the instructions of the manufacturer is not properly followed because of neglect and if proper maintenance is not done the value of equipment is reduced. The reduction in value of the equipment because of this reason is called depreciation due to deferred maintenance and neglect. **Depreciation Due to Functional Condition** **a) Inadequacy** This is a functional depreciation. Inadequacy means reduction in efficiency of an asset. This may result even if any equipment is servicing under proper precautions and sufficient maintenance is provided, there is fall in efficiency with the lapse of time. **b) Depreciation by obsolescence** Obsolescence is the depreciation of existing machinery or equipment due to invention of better or more efficient equipment or process etc. even if the equipment is in good condition it becomes useless or uneconomical to use it due to introduction of new machines to the market which are more efficient and more economical. The reduction in value of the existing equipment due to new inventions is called obsolescence.			
	OR			
X				
a	**Operating Characteristic Curve (OC CURVE)** The OC curve is the most important aid in the choice of sampling plan. It is a graph between fraction defective P in a lot against the probability of acceptance Pa. It is possible to calculate the proportion of lots that will accepted when the lot size, sample size and acceptance number are known. The OC curve is divided into Three Zones Acceptable quality region Indifferent quality region Rejectable quality region The OC curve passes through 5 important points 1. Pa=100% 2. AQL 3. Pa= 50% 4. LTPD. 5. Pa=0% **Acceptable Quality Region** Lots at this level are good quality, they will be readily accepted. The consumer will accept all lots which have fraction defective represented by AQL or less. The probability of acceptance is very high for the lots submitted for inspection with fraction defective specified AQL or less. These lots are considered to be good lots. In fact all such lots are to be accepted.	1 1	8	8



2

Producers Risk (A) There always remains some risk that a good lot will be rejected because of bad sample. It is the loss to the producer therefore producer has to suffer and tolerate this risk. The probability of rejecting a good lot which otherwise would have been accepted is called producers risk. This is represented by letter α. The producer can reduce this risk by producing a better quality products specified by AQL. The producers risk may be about 5% for certain sampling plans. 1

Rejectable Quality Region The quality of the lots submitted in this region are to be unsatisfactory. They have defectives more than the RQL nearly all the lots will be rejected. The probability for acceptance is very low. 1

Consumers Risk(ß) Very few lots may be accepted because of g good sample from bad lot. Its probability may be 5% to 10%. It is loss to the consumer because unsatisfactory items may be accepted. This is called consumers risk. It is represented by the letter ß. 1

Indifferent Quality Region In this region the submitted lot consist of fraction defectives more than AQL.it is not advisable to accept the such lots because defectives are more than the specified by AQL. A lot in this zone worse than AQL and better than RQL. No decision can be given about its acceptance or rejection. 100% inspection is required to eliminate this indecision. 1

b

Principal Constituents of Estimation

The constituents of estimation are given below

1. Design Time
2. Drafting time
3. Time and motion studies, planning and production control time
4. Design and arrangement of special items
5. Experimental work
6. Material
7. Labour
8. Time allowances
9. Overheads

7 | 7 | 7

Design time

It is the time required to design a particular product. The cost of the design is estimated on the basis of similar products already designed in the past or on the basis of good judgment of designer.

Drafting time

Drawings are required for all the products manufactured in a factory. This

drafting work can be taken up after the design work is over. The product is to be split up into simple parts and part drawings and assembly drawings are prepared by the draftsman as required to the factory workers in different production shops for manufacturing. Drafting time is the time required for preparing necessary drawings or blue prints for production. The estimated cost is calculated on the basis of standard rates of remuneration paid per hour to the draftsman.

Time and motion studies, planning and production control time

Time and motion studies may be conducted to eliminate all directed, wasteful time and movements. The time required for this may be estimated with the help of past records and in consultation with experienced engineers. The time needed for planning and production control may be calculated carefully to fix up appropriate delivery dates and cost.

Design and arrangement of special items

The cost of the special facilities are required for manufacturing in different production shops such as patterns, dies, jigs fixtures recorded to add the same in the selling price of articles.

Experimental work

Experiments are to be performed on old and new methods for ensuring quality product for lowest market price. The services of highly qualified and trained personnel are needed for experimental work. The cost of such activities may be estimated.

Materials

The material cost can be estimated when quality, quantity of material and their market rates are known. Quantity of materials required may be calculated with the help of samples or drawings. Estimator has to add necessary allowances for finishing, holding, turning etc. to size of finished products in drawings. Estimator has to prepare rough drawings after adding all allowances and calculate their volumes and weight. Then the cost of direct material can be estimated taking into consideration of direct materials and indirect materials required.

Labor

Labour cost plays important role in estimating total cost of a product.

Estimator should have technical knowledge about various machines used in production and different operations performed on them. Different allowances like personal, fatigue, tool changing should also be taken into consideration.

Time allowances

The time allowances generally allowed are given below

Set up time - time required for setting and fixing job and tools

Operation time - time required to perform all the elements of an operation. It include handling time, machining time

Tear down time - it includes time for removal of tools, removal of jigs, fixtures, cleaning chips etc.

Miscellaneous allowances - includes personal allowance, fatigue allowances, toll changing and grinding allowances, measurement and checking allowances, cleaning allowances etc.

Overheads

The expenditure cannot be definitely charged to any particular product during production. It includes

Indirect material cost - these are the cost of grease, coolants, cotton

	waste, water etc. Indirect labour cost - salaries of supervisor, designers, helpers etc. Administrative overheads Salaries of officers, salaries of staff working in office and expenses on telephone, insurance etc. Selling overheads Expenses on salaries of salesman, expenditure on advertisements etc. Depreciation Depreciation of building furniture, equipment repair and maintenance charges etc. Other expenses of any also beaded to these overheads.			

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