SUMMER– 19 EXAMINATION

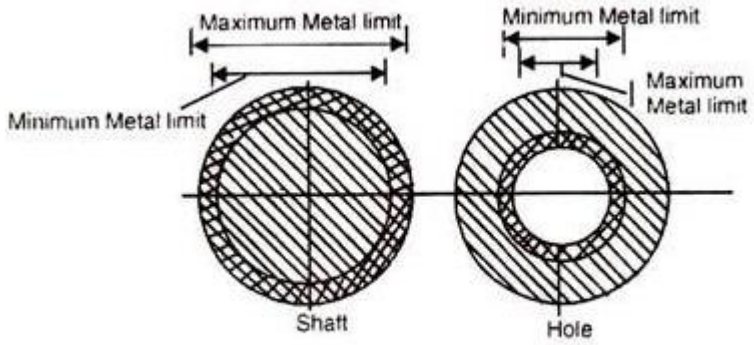
Model Answer

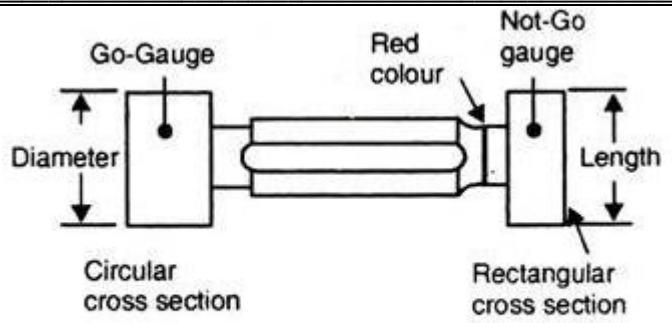
Subject Code: 17530

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. No.	Sub Q. N.	Answer	Marking Scheme
1	a i	**Explain the need of inspection in industries.** Inspection is an important tool to achieve quality concept. It is necessary to assure confidence to manufacturer and aims satisfaction to customer. Inspection is an indispensable tool of modern manufacturing process. It helps to control quality, reduces manufacturing costs, eliminate scrap losses and assignable causes of defective work. The inspection and test unit is responsible for appraising the quality of incoming raw materials and components as well as the quality of the manufactured product or service. It checks the components at various stages with reference to certain predetermined factors and detecting and sorting out the faulty or defective items. It also specified the types of inspection devices to use and the procedures to follow to measure the quality characteristics. Inspection only measures the degree of conformance to a standard in the case of variables. In the case of attributes inspection merely separates the nonconforming from the conforming. Inspection does not show why the nonconforming units are being produced.	**04 marks for explanation**

		Inspection is the most common method of attaining standardization, uniformity and quality of workmanship. It is the cost art of controlling the production quality after comparison with the established standards and specifications. It is the function of quality control. If the said item does not fall within the zone of acceptability it will be rejected and corrective measure will be applied to see that the items in future conform to specified standards.	
	ii	**Define Taylor's principle as applied to design of limit gauges** The Taylor's Principle of gauge design gives two statements. Statement 1: The "Go" gauge should always be so designed that it will cover the maximum metal condition (MMC), whereas a "NOT-GO" gauge will cover the minimum (least) metal condition (LMC) of a feature, whether external or internal.  Maximum and minimum metal condition for Taylor's principle. **Statement 2:** The "Go" gauge should always be so designed that it will cover as many dimensions as possible in a single operation, whereas the "NOT-GO" gauge will cover only one dimension. Means a Go plug gauge should have a full circular section and be of full length of the hole being checked as in shown figure.	**02 m for each statement**



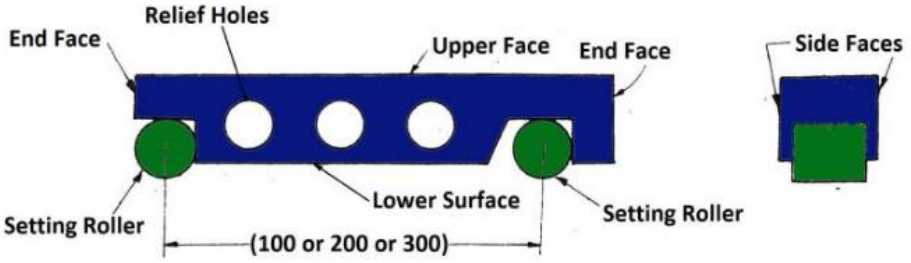
Go and Not-Go gauges for hole (Taylor's principle).

Note:- fig. not essential if drawn, give advantage

iii **Explain with sketch construction and working principle of sine bar** — **02 marks for sketch 02 marks for explanation**

Construction of the Sine Bar

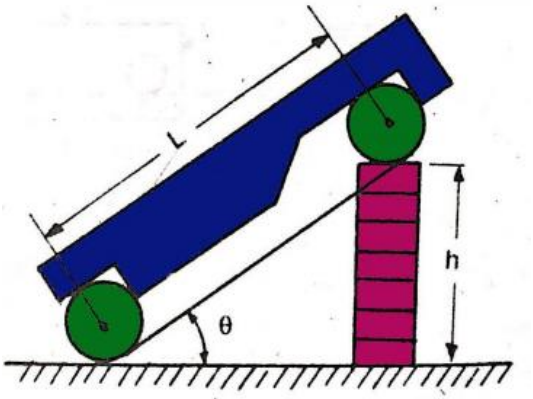
- Sine Bar is made up of High Carbon steel, High Chromium (Corrosion resistance), and Hardened. It contains two rollers with the Steel Bar.
- The two rollers are very accurate and Highly precise and truly equal in Diameters.
- When we place the Sine bar on the truly flat surface, The axes of the two rollers are parallel to each other and also parallel to the upper face of the Sine bar.
- There is the presence of relief holes in the steel bar. (To handle the sine bar easily and also reduces the overall weight.
- The normal distance between the two rollers usually available in 100 mm, 200 mm or 300 mm.
- There are two grades in sine bars. A grade, B grade.
- A grade sine bar is having the accuracy of 0.01mm/m length, B grade sine bar is having the accuracy of 0.02mm/m length.



Working Principle of Sine Bar

- As you can see, one Roller is placed on the surface plate and the other one is placed at a height ***h*** with the help of slip gauges.

- Where ***L*** is the distance between the two setting rollers of the Sine bar.
- From the above trigonometric formulas Sine θ = Opposite /Diagonal = ***h***/***L***
- From this, we can write θ = Sin^{-1}(***h***/***L***).

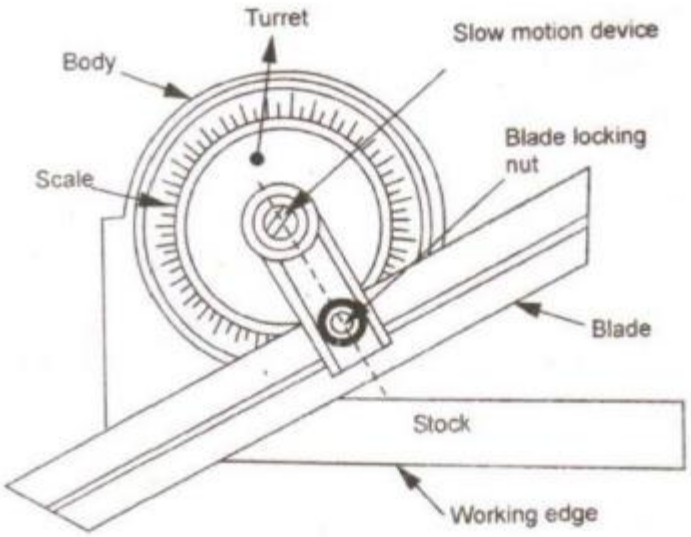


iv **Differentiate between alignment test and performance test** — **any four points , 01 each**

alignment test	performance test
1. Various geometric checks are carried out called as alignment tests.	1. Actual performance of job on machine tool is called as performance test.
2. These tests are carried out at static condition	2. These tests are carried out at working condition
3. In these tests positions of components and displacement relative to one another are checked.	3. In this test the jobs manufactured on machine and its tolerance limits as per design are checked.
4. E. g. squareness, flatness , level, true running, axial slip etc can be checked.	4. E.g. manufacturing of job on lathe machine.
5. The alignment is done to obtain the said accuracy on machining of parts by some geometric tests.	5. It is carried out for the purpose of checking accuracy of a machine tool.
6. Quality of work piece depends upon the alignment of various machine parts.	6. Quality of work piece depends upon alignment of parts and other cutting parameters such as speed , feed, depth of cut etc.

b i **List any six major objectives of metrology.** — **six points , 01 each**

(1) Thorough evaluation of newly developed products, to ensure that components designed are within the process and measuring instrument capabilities available in the plant.
(2) To determine the process capabilities and ensure that these are better

		than the relevant component tolerances. (3) To determine the measuring instrument capabilities and ensure that these are adequate for their respective measurements. (4) To minimise the cost of inspection by effective and efficient use of available facilities, and to reduce the cost of rejects and rework through application of Statistical Quality Control Techniques. (5) Standardisation of measuring methods. This is achieved by laying down inspection methods for any product right at the time when production technology is prepared. (6) Maintenance of the accuracies of measurement. This is achieved by periodical calibration of the metrological instruments used in the plant. (7) Arbitration and solution of problems arising on the shop floor regarding methods of measurement. (8) Preparation of designs for all gauges and special inspection fixtures.	
	ii	**Draw neat sketch of universal bevel protractor and write the procedure for measure angle of work piece.**  *Bevel Protractor* **Procedure: -** 1. Note down the least count of the bevel protractor. 2. Keep the work piece on the surface plate. 3. Fix the slide of bevel protractor to the turret. 4. Keep one of the surfaces of the specimen on the working edge and rotate the turret. Remove the slide on to the other surface. 5. Fix the centre, after matching both the faces and note down the reading. 6. Repeat the experiment for different faces.	**sketch 3m, procedure 3m**

2 a **Distinguish between line standard and end standard.** **any four points , 01 m each**

line standard	end standard
1. When the length being measured is expressed as the distance between two lines, this is known as line standard.	1. When the length being measured is expressed as the distance between two surfaces or ends, this is known as end standard.
2. A scale is quick and easy to use over a wide range of dimension.	2. They are time consuming to use and prove only one dimension at a time.
3. Line standards are not as accurate as end standards and cannot be used for close tolerance measurement.	3. End standards are highly accurate and well- suitable to close tolerance measurement.
4. A steel scale can be read to about ± 0.2 mm of true value.	4. Close dimensional tolerance as small as 0.0005 mm can be obtained.
5. The scale graduations are not subject to wear although significance wear on leading end leads to under sizing.	5. They are subjected to wear on their measuring faces. Also wringing of slip gauges leads to damage.
6. Scales are subjected to parallax error of reading. They may be positive or negative reading.	6. The parallax error is not associated with such type of measurement because the distance is measured between two flat surfaces.
7. Errors due to inaccuracy of graduations engraved on the scale are possible.	7. Such errors are not possible with end standards.
8. A scale does not provide a **"built in"** measuring datum.	8. They have a **"built in"** measuring datum as their measuring faces are flat and parallel.

	b	**State the limitations of sine bar** Any unknown projections present in the component will cause to induce errors in the angle measured. For the building of the slip gauges, there is no scientific approach available and it is to be built on the trial and error basis and it is a time-consuming process. During measurement of an angle by using sine bar, the length of the sine bar should be greater than or equal to a length of the component to be inspected. If the length of the component Inspected is very long then there is no sine bar available which is longer than the Component. In such cases, the sine bar will be used in association with Height Gauge for measurement of the angles. Sine bar not recommended to be used for measurement of angle greater than 45 degrees.	**any four points , 01 m each**
	c	**Explain importance of surface finish.** The term defines the vertical deviations of a measured surface from its ideal form. If these deviations are substantial, the surface is rough; if they are minor the surface is smooth. For many engineering applications, the finish on a surface can have a big effect on the performance and durability of parts. Rough surfaces generally wear more rapidly and have greater friction coefficients than smooth surfaces. Typically, roughness is a dependable predictor of mechanical part performance, as irregularities tend to form nucleation sites for breaks or corrosion. Conversely, roughness may encourage desired adhesion. The Importance of Surface Finish in Components for the Aerospace and Medical Industries. Introduction In the aerospace and medical fields the surface finish of machined components is of utmost importance. High pressure hydraulic systems and fuel injections systems in particular require high quality surfaces and precisely defined features, such as o-ring grooves, if system integrity is to be maintained. In the medical field, equipment manufacturers and pharmaceutical producers demand stringent specifications with respect to surface finish.	**04 marks for explanation**

	d	**Explain the following errors in gears.** **I) Backlash** Backlash is a clearance or lost motion in a mechanism caused by gaps between the parts. It can be defined as "the maximum distance or angle through which any part of a mechanical system may be moved in one direction without applying appreciable force or motion to the next part in mechanical sequence". **ii) Runout** *Runout is a characteristic of gear quality that results in an effective center distance variation. As long as the **runout** doesn't cause loss of backlash, it won't hurt the function of the gear, which is to transmit smooth motion under load from one shaft to another. However, **runout** does result in accumulated pitch variation, and this causes non-uniform motion, which does affect the function of the gears. Runout is a radial phenomenon, while accumulated pitch variation is a tangential characteristic that causes transmission error. Gears function tangentially. It is also possible to have a gear with accumulated pitch variation, but little or no **runout**.*	**02 m , each parameter**
	e	**list objectives of quality control.** *. 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*	**any four points , 01 m each**

3 a

Wringing of slip gauges

Wringing defined as the property of measuring surfaces of a gauge block of adhering, by sliding or pressing the gauge against the measuring faces of other gauge block or the reference face of datum surfaces, without the use of any extraneous means.

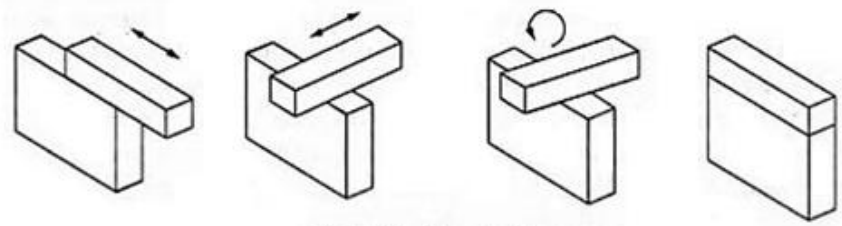


Fig. Wringing of slip gauges

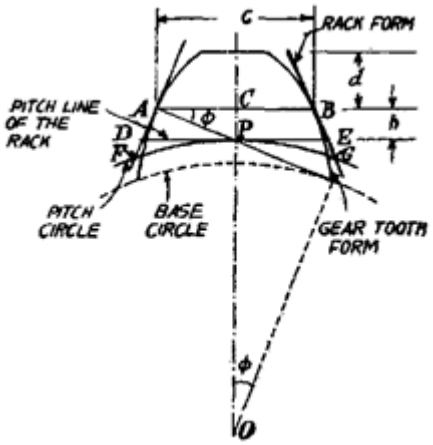
Note:- Fig. not essential if drwan give advantage

04 marks for definition

b

Unilateral System	**Bilateral System**
In this system the dimensions of a part is allowed to vary only on one side of the basic size i.e tolerances lies wholly on one side of the basic size either above or below it.	In this system the dimensions of a part is allowed to vary on both the sides of the basic size i.e the limits of tolerances lies on either side of the basic size.
This system is preferred in interchangeable manufacture especially when precision fits are required.	This system is used in mass production where machine setting is done for the basic size.
Advantage of this system is that GO gauge ends can be standardized as the HOLES of different tolerance grades have the same lower limit and all the SHAFTS have same upper limit.	GO gauge ends can not be standardized.
Example +0.02 +0.02 -0.01 +0.01 -0.00 -0.02 25 25 25	Example +0.02 +0.02 -0.02 -0.01 25 25

any four points , 01 m each

	c	**Constant Chord method: -** Constant chord of a gear is measured where the tooth flanks touch the flanks of the basic rack. The teeth of the racks are straight and inclined to their center lines at the pressure angle. The tooth thickness of the rack along this line is equal to the arc tooth thickness of the gear round its pitch circle. The constant chord is defined as the chord joining those points, on opposite faces of the tooth, which make the contact with mating teeth when the center line of the tooth lies on the line of the gear center. The value of AB and its depth from the tip, where it occurs can be calculated mathematically and then verified by an instrument Pd = arc PF =1/4 * π * m C = constant chord =2AC = (π/2mcos2φ)  	**03 marks for explanation, 01 mark for sketch**
	d	i) Roughness:- surface roughness refers to relatively finely spaced micro geometrical irregularities. It is also called as primary texture. ii) Lay: - It is the direction of predominant surface pattern produced by tool marks or scratches. iii) Waviness:- waviness consists of those irregularities which are of greater spacing than roughness and it occurs in the form of waves. iv) Sampling Length:- It is the length of profile necessary for the evaluation of the irregularities to be taken into account. It is also known as cut off length.	**01 mark each**
	e	**Cost of quality and value of quality :** **Cost of quality:-** the cost of carrying out the company's quality functions are known as costs of quality. These includes:- 1. Market research cost of discovering the quality needs of the customer. 2. The product research and development costs of creating a product concept which will meet these quality needs.	**02 marks for each explanation**

3. The design costs of translating the product concept into information which permits planning for manufacture.
4. The cost of manufacturing planning in order to meet required quality specifications.
5. Cost of inspection and test
6. Cost of defect prevention
7. Cost of scrap, quality failures
8. Cost of quality assurance .
9. Field service and such other factors attributed to the quality improvement and maintenance.

Value of Quality:- the value of quality can be defined as the return direct or indirect gained by the manufacturer due to mission of quality control.

Value of quality is composed of :

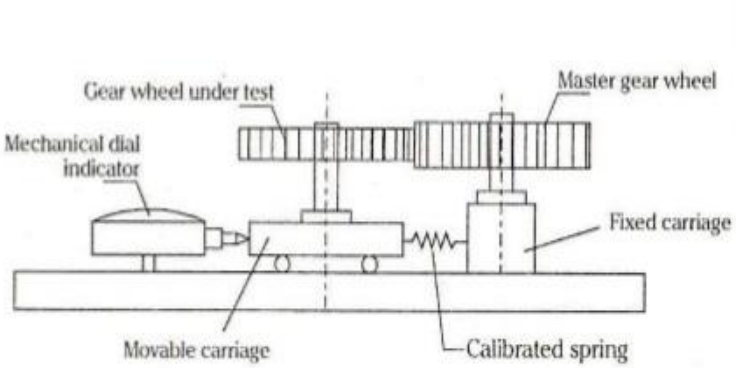
1) Value inherent in the design
2) Value inherent in the conformance to that design.

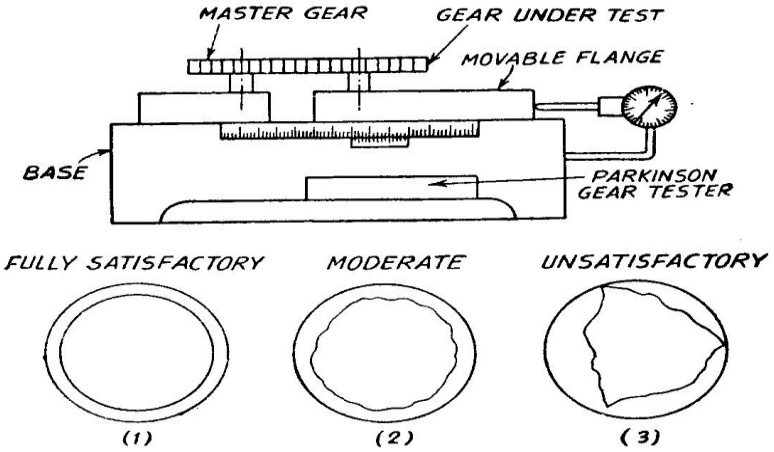
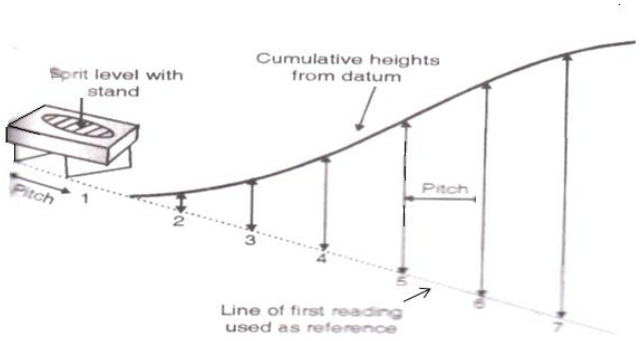
The value inherent in the design is usually called as grade. Grade is the variation in specification for the same functional use.

The value of quality is to be assessed considering various factors ,

1) The saving due to increased production.
2) Reduction in scrap and rework cost.
3) Increased sales of good quality product.
4) Indirect factors such as
   a) Reputation of the manufacturer and goodwill of the customer.
   b) Psychological stability in the enterprise due to increased sales and security of job workers.

	f	**Limitations of Acceptance sampling:-** 1) There are risks of accepting bad lots and rejecting good lots. 2) The samples usually provide less information about the product. 3) Some extra planning is necessary. 4) Extra Documentation is required.	**any four points 01 mark for each**
4	a i	**Characteristics of good comparator:-** 1. Robust in design and construction. 2. Linear characteristics of scale . 3. High magnification. 4. Quick response to input. 5. Minimum wear of contact point. 6. Free from oscillations. 7. Free from back lash. 8. Output must be easily readable and understandable. 9. Low in cost. 10. Less maintenance.	**Any four 01 mark each**
	ii	**Interchangeability:-** In mass production system the components are produced in one or more batches by different operators on different machines. Under such conditions in order to assemble the mating components with a desired fit, a strict control is exercised and the parts are manufactured with specified tolerance limits. When a system of this kind is used any one component selected at random will assemble correctly with any other mating component that too, selected at random, the system is called interchangeable assembly. **Advantages of Interchangeability:-** i) Assembly time is reduced, as the operator is not required to waste his/her skill in fitting the mating components by trial and error. ii) There is an increased output with reduced production cost. iii) Improve quality and reduce the time for operation. iv) The replacement and worn-out or defective parts and repairs becomes very easy.	**02 marks for explanation, 02 marks for advantages any two(01 mark for each advantage)**

		v) The cost of maintenance and shutdown period is also reduced to minimum.	
	iii	**Parkinson's Gear Tester :** Construction: 1. One fixed spindle and other movable spindle is mounted on a flat base. 2. The movable spindle moves along with base by rolling action on the main base plate. 3. A Master gear is mounted on the fixed spindle and gear to be tested is mounted on movable spindle. 4. The dial gauge is set to note the errors. **Working:** when master gear is rotated slowly, a gear to be tested will also get rotation movement because of their meshing. Errors in the manufactured gear cause the gear to move away from the centerline of spindle. When gear to be tested moves the floating body also moves by the same distance. Because of displacement of floating body dial gauge gives displacement. The variation in the readings can be observed and plotted in the graphical format. A recorder can be fitted in the form of waved circular or rectangular chart and records made of the irregularities in the gear under test. Below fig shows a reproduction of a few typical charts with a reduced scale and the magnified radial errors. Gear 1 is an unsatisfactory, Gear 2 is moderate gear and Gear 3 is fully satisfactory.  	**02 marks for explanation, 02 marks for sketch**

			
	iv	**Straightness checking using spirit level.** - straight line is drawn on the surface whose straightness is to be checked as a reference line. - A sensitive spirit level, fitted with two feet at a convenient distance apart is moved along this line in steps equal to the pitch distance between the centre lines of the feet. - For each position the reading is noted. - Variation in the bubble position represents angular variation in the surface. - these are converted into differences in height of the feet above or below the straight point. 	**03 marks for procedure, 01 marks for sketch**
	v	**Importance of TQM:-** Benefits to customers:- 1) Better customer care. 2) Greater satisfaction.	**Any 04 points 01 mark each**

		3) Fewer problems with the product or service. Benefits for the company:- 1) Better product quality. 2) Staffs are more motivated and quality conscious. 3) Productivity improvement. 4) Reduced quality cost. 5) Enhanced problem solving capacity. 6) Increased market. 7) Increased competitive position of the firm, improved probability. 8) Good public image of the enterprise by helping it to provide goods and services of higher quality at lower cost to the society. 9) Improvement in human relations and work area morale. Benefits to staff:- 1) Empowerment. 2) Enhancement of job interest and security. 3) More training and improvement in skills 4) More recognition. 5) Reduced employee grievances.	
	b i	**Sigma Comparator:-** Fig shows the construction details of the sigma comparator. The vertical beam is mounted on flat steel spring and connected to fixed members which in turn are screwed with back plate. The shank at the base of the vertical beam is arranged to take a measuring contact selected from the available range. The stop is provided to restrict movement at lower extremity of the scale. Hinged assembly carrying the forked arms. The metal ribbon attached to the forked arms passes round the spindle causing it to rotate on specially designed miniature ball bearings. The damping action to the movement is affected by a metal disc mounted on the spindle rotating in a	**03 marks for explanation, 03 marks for sketch**

magnetic field between a permanent magnet and a steel plate. The indicating pointer is secured to a boss on the disc

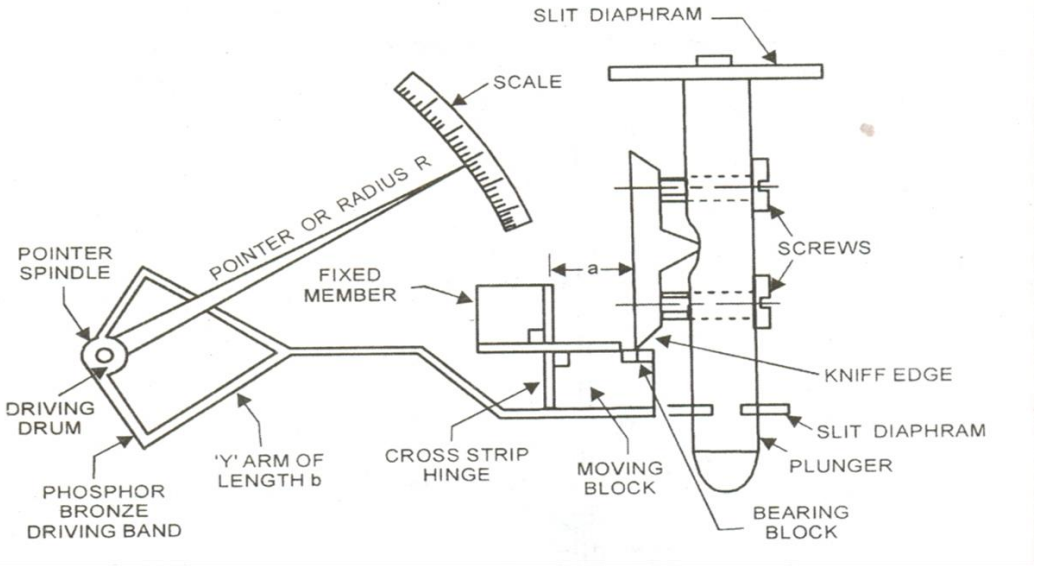
The trigger is used to protect the measuring contact. At the upper end of the measuring beam an adjustable screw is provided for final zero setting on the scale.

Total magnification of instrument is ((L/a) x (i/r)).

Where, L= effective length of the arm

a= distance of the knife edge from the pivot.

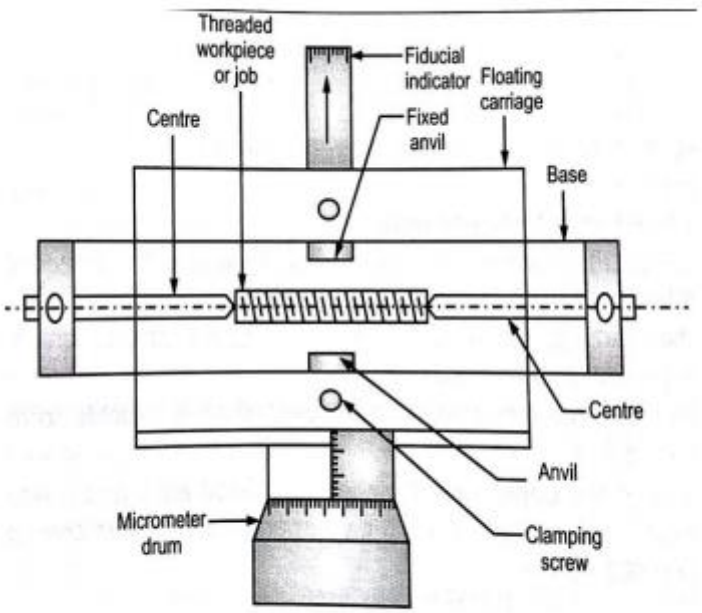
l= pointer length , r =radius of the driving drum



Sigma Comparator

ii **Floating Carriage Dial Micrometer:-** **04 marks for explanation, 02 marks for fig**

- Fig. Shows a floating the carriage micrometer it consist the cast iron base and two centers.
- Two centers are provided for mounting the work piece. The centers can remove the in and out to accommodate the work piece of different sizes and the centers can be clamped by operating these levers.
- Perpendicular to the center axis we have another axis wherein the micrometer which the large diameter thimble is provided.
- on the other side fiducial indicator is provided to indicate the measurement pressure.
- The work piece is mounted between the center and measurement can

		be taken using this micrometer and for all measurements. - Hooks arrangement is provided, So that the rods can be hung from the hooks,. - This will help in the measurement of minor diameter and in the effective diameter. - so this carriage which is carrying the micrometer moves on the ball tracks freely hence it is called the floating carriage micrometer for measurement of minor diameter reading is taken using the suspended rods  **Floating carriage diameter measuring machine**	
5	a	**Two wire method** Two wire method:- In this method the effective diameter of screw thread is measured by placing two wires or rod of identical diameters between the flanks of the thread as shown in fig. and measuring the distance over the outside of these wires. - in two wire method wires of suitable size are placed between the standard and the micrometer anvils and first micrometer reading is taken. - Let the micrometer reading over standard and wires=R1. -the standard is then replaced by the screw thread to be measured and the micrometer reading is taken. - Let the micrometer reading over screw thread and wires = R2.	**Description 06 marks, fig 02 mark**

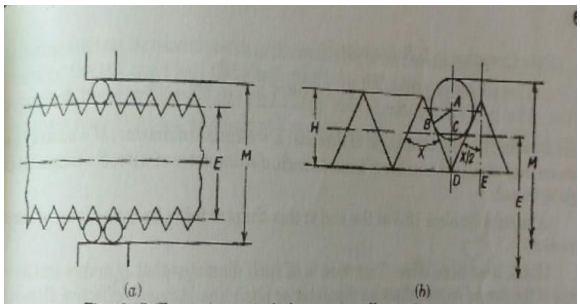
The diameter of the standard = S

The diameter under the wires = T

The effective diameter of the screw = E

Thus E = T+ P Where, T = S – (R1 – R2) And

P is a constant calculated for different threads, it depends upon the diameter of wire and pitch of the thread.

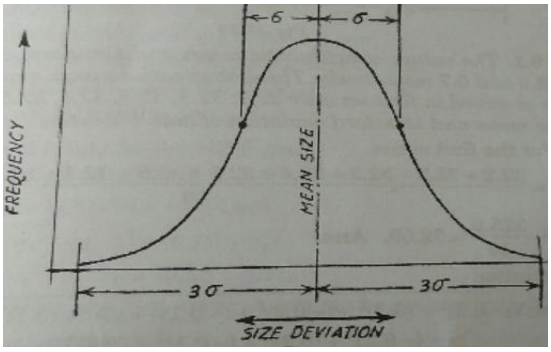


b i

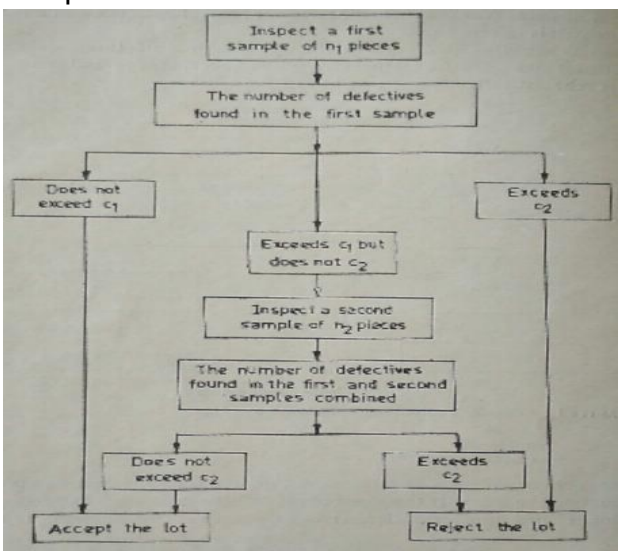
Differentiate variable and attribute inspection any 4 parameters

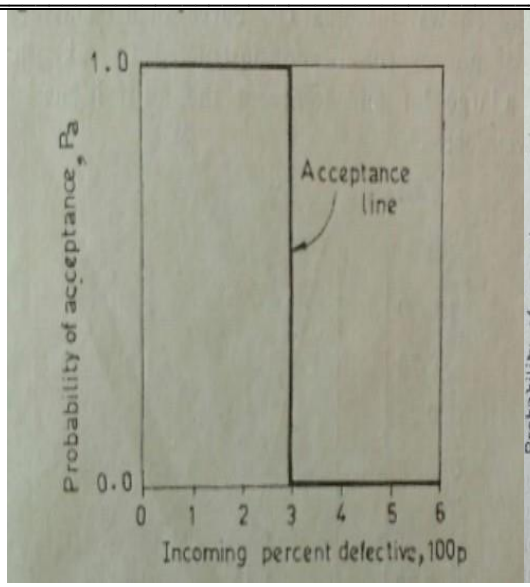
Any four parameters , 01 mark each

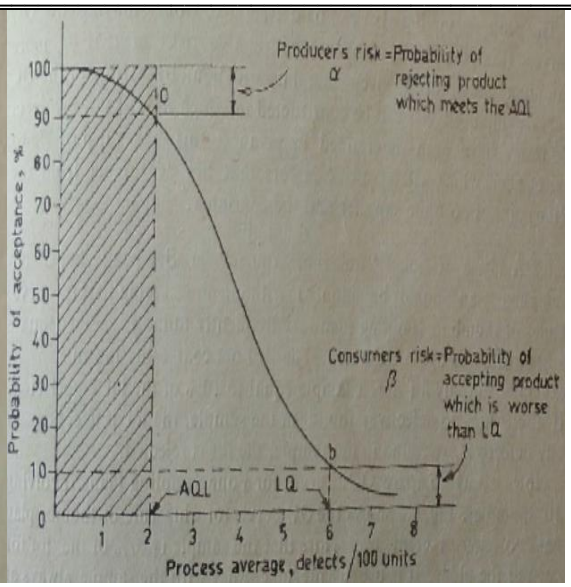
Sr.No	Variable Measurement	Attribute Measurement
1	In this measurement the record is made of an actual measured quality characteristics such as dimensions of a part in mm, hardness in Rockwell units, temperature in degree centigrade,	In this measurement the record shows only the number of articles conforming and the number of articles falling to confirm to any specified requirements. Such as cracks in sheet by spot welds, the number of defective pieces found in a sample.
2	Precision instruments are used to measure the quality characteristics.	The conformance or non-conformance is usually inspected with the help of Limit gauges i.e GO and NO-GO gauges.
3	It gives detailed information about the product quality characteristics.	It gives information about whether the part are acceptable or not.
4	It is time consuming	It requires less time
5	Higher measurement cost	Inspection cost is less

		6	The data obtained is called continuous data and can have any value	The data obtained is called discrete data. It has integer value.	
		7	To represent the collected data X bar and R chart or X bar and 6 (standard deviation) charts are used	P and C charts are used	
		8	It may cause fatigue to the operator.	It does not cause fatigue to the operator	
	ii	**Normal distribution curve and its characteristics** Normal distribution curve A bell shaped curve which is symmetrical about the average value, high at middle and diminishes gradually as the distance increases away from the average is called normal or Gaussian curve. Characteristics 1.It is symmetrical about its mean. 2. It is bell shaped. 3. It tends between ±∞  		**02 mark for curve , 02 mark for characteristics (any two)**
	c	Rearranging the data 2,2,3,3,4,4,4,5,5,5 Mean 2+2+3+3+4+4+4+5+5+5/10 =37/10 =3.7 Mode Mode are 4 and 5 (bimodal data) Median 4			**02 marks each**

6	a i	(i) Six Sigma with suitable example Methodology of six sigma ;- The fundamental objective of six sigma methodology is focus on process variation, process improvement, variation control. Six sigma is scientific approach for eliminating defects. In general there are two six sigma methodologies 1. For existing products / processes DMAIC (Define , Measure, Analysis, Improve, Control) 2. For development of new products / processes DMADV (Define , Measure, Analysis, Design, Verify) Benefits of six sigma:- 1) Customer driven 2) Continuous improvement process. 3) It helps to increase customer satisfaction. 4) Improve efficiency and effectiveness in process **(Any appropriate example related to six sigma concept to be considered)**	**Description 03 marks, example 01 mark**
	ii	**(i) Importance of QS14000 standard** QS 14000 is the international **standard** that specifies requirements for an effective environmental management system (EMS). It provides a framework that an organization can follow, rather than establishing environmental performance requirements. QS 14000 is an internationally agreed standard that sets out the requirements for an environmental management system. It helps organizations improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders.	**Explanation 04 marks**
	b i	**(i) Double sampling plan** Double sampling plan:- In double sampling plan the decision on acceptance or rejection of the lot is based on two samples Example:- Parameters, N= lot size = 500 n1= number of pieces in the first sample. =35 C1= acceptance number for the first sample. =1 n2= number of pieces in the second sample. =50 C1= acceptance number for the second sample. =4 1. 1. Take a first sample of 35 items from a lot of 500 and inspect. 2. Accept the lot on the basis of first sample, if it contains 0 or 1	**04 marks**

		defective. 3. Reject the lot on the basis of first sample if it contains more than 4 defectives. 4. Take a second sample of 50 items if the first sample contains 2,3 0r 4 defectives. 5. Accept the lot on the basis of first and second sample combined, if the combined sample of 85 items contains 4 or less defectives. 6. Reject the lot on the basis of combined sample if the combined sample contains more than 4 defectives.  **(Candidate may explain concept in form of flow chart then equal weight age to be given)**	
	ii	**Explain OC curve. Draw Ideal OC curve & Actual OC curve** An Operation Characteristic curve commonly called OC curve provides the means of evaluating the operation of an acceptance sampling plan. It depicts the varying conditions of incoming materials and illustrates the risk inherent in a sampling plan at each quality level of the incoming material. Thus every sampling plan has an OC curve. An OC curve shows , for every possible fraction defective 'p' in a given lot submitted for inspection , the probability 'pa' that such a lot will be accepted by the acceptance sampling plan that the OC curve represents. It is the graph drawn with lot fraction defective on X axis against probability of acceptance on Y axis. Actual OC curve Ideal OC curve	**Description 02 marks Fig 02 marks**





c Arranging the data in tabular form

lot no	qty inspected	no. of defectives	Fraction Defectives	% defectives
1	750	48	0.064	6.4
2	750	83	0.1106	11.066
3	750	70	0.0933	9.333
4	750	85	0.1133	11.333
5	750	90	0.12	12
6	750	56	0.07466	7.466
7	750	54	0.072	7.2
8	750	71	0.09466	9.466
9	750	36	0.048	4.8
10	750	49	0.06533	6.533
11	750	29	0.03866	3.866
12	750	51	0.068	6.8
13	750	28	0.0373	3.733
14	750	33	0.044	4.4
15	750	37	0.0493	4.933
16	750	80	0.1066	10.666
17	750	70	0.0933	9.333
18	750	48	0.064	6.4
19	750	67	0.0893	8.9333
20	750	57	0.076	7.6
	15000	1142		

Rearranging data in tabular form 01 mark, Calculations 0f p bar 01 mark, UCL 02 marks, LCL 02marks Control chart 01 mark, Conclusion 01 mark

$\bar{p} = \frac{\text{Total defectives}}{\text{Total qty. inspected}} = \frac{1142}{15000} = 0.07613$ or 7.613%

UCL $\bar{p} + 3\left[\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right]$

$= 0.07613 + 3\left[\sqrt{\frac{0.07613(1-0.07613)}{750}}\right]$

$= 0.07613 + 0.02905$

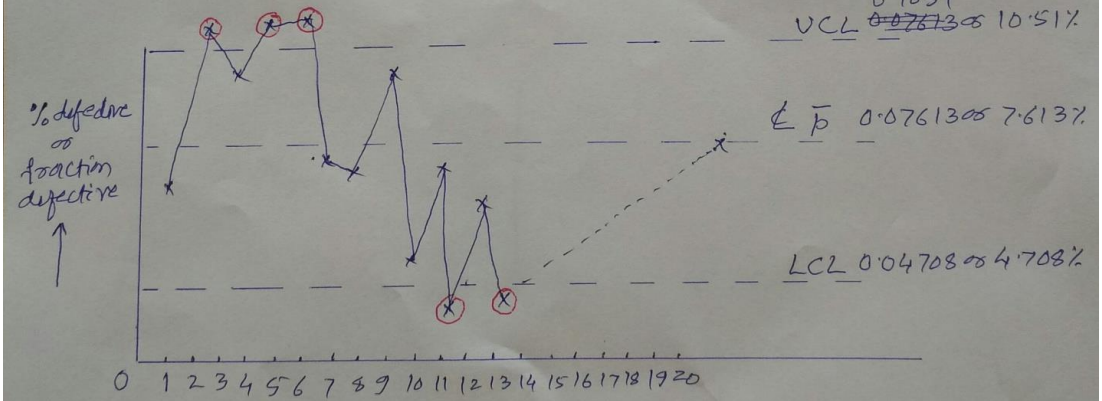
$= 0.1051$ or 10.51%

LCL $\bar{p} - 3\left[\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right]$

$= 0.07613 - 3\left[\sqrt{\frac{0.07613(1-0.07613)}{750}}\right]$

$= 0.07613 - 0.02905$

$= 0.04708$ or 4.708%



Conclusion: From p chart it is evident that process is out of statistical control.