WINTER – 15 EXAMINATION

Subject Code:17530 **Model Answer**

Q1 (A)

(a) Define line and end standard. Give one application of each.

Line standard is the standard in which distance is measured between two parallel lines

Application: Steel rule, measuring tape

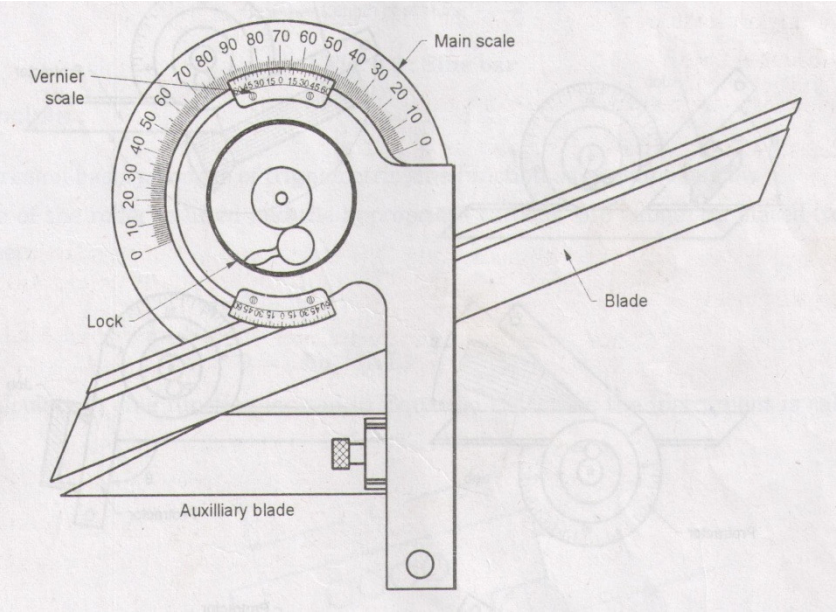
When the distance is measured between two parallel surfaces it is called as end standard

Application: Slip gauges, End bars

(Definition of line standard-01 mark, Application-01 mark, Definition of end standard-01 mark, Application-01 mark)

(b) Draw a labeled sketch of bevel protractor. State its uses.

Sketch:



Uses:

1. It is used to measure known / unknown angle.
2. It is used to set the angle on machine tools.

(Labeled sketch of bevel protractor-03marks, Uses- 01 mark)

(c) Differentiate between gauge and comparator

Gauges	Comparator
Gauge is device designed to compare the manufactured component against the given drawing.	Comparator is device designed to compare known-known, known – unknown, unknown- unknown parameters.
Gauge can only verify the manufactured component is acceptable or rejected.	Comparator gives the readings of measurement of the manufactured component.
Low in cost	More in cost
Easy to use on shop floor	Needs pneumatic or other sources to use on shop floor
Limited range of application	Large range of application
Ex- Ring gauges, Plug gauges, Snap gauges	Ex- Pneumatic, Electrical, Mechanical comparators

(01 mark for each point of differentiation, at least four points are expected)

(d)

Solution:- Given data

Length of sine bar (l) = 100 mm,

Angle (θ) = 14^0

Height of slips required (h) = ?

Sin θ = h/l

Sin 14= h/100,

h = 24.192mm. ----- **01 mark**

For 24.192 mm , slips are as follows using M45 set **(correct combination of slips----03 marks)**

Slips	Remaining size	Slips
1.002	23.19	01
1.09	22.1	01
1.1	21	01
1	20	01
20	0	01

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(B)

(a)

Concept of cost of quality:- The cost of carrying out company's quality functions in order to meet customers' requirements is known as cost of quality. It includes;

Cost of prevention

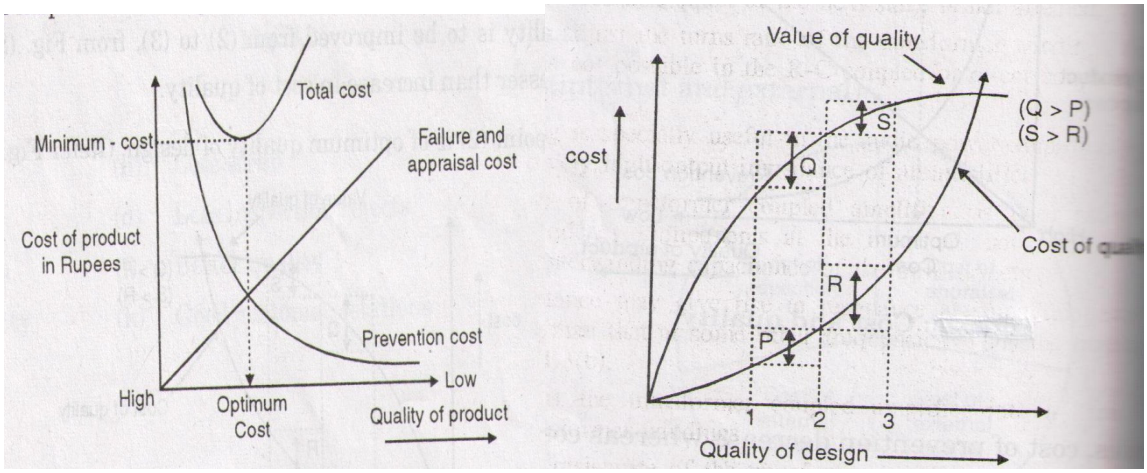
Cost of appraisal

Cost of failures

Concept of value of quality:- the value of quality is the direct or indirect returns gained by the organization through its mission of quality. It includes;

Value inherent in the design.

Value inherent in the conformance of the design



(Concept of cost of quality-02, graph-01, Concept of value of quality-02, graph-01 marks)

(b)

" inspection is part of quality"- inspection is the checking, verification of raw material, in process, semi finished or finished components. It is the first step to distinguish between accepted or rejected components. Inspection basically involves;

1. Interpretation of specifications/ drawings.
2. Measurement of dimensions or other related parameters.
3. Selection of proper instruments, gauges.
4. Selection of units of measurements.

5. Comparison between specified and measured values.

6. Based on the act of comparison proper decisions to be taken.

Inspection is the first and basic act to towards achieving the quality defined from customers requirements, hence inspection is part of quality.

(Examiner should refer above for the comparison of the justification given by the examinee and give the marks)

Q2

(a)

Advantages of mechanical comparators -- **any four advantages ½ mark each**

1. Cheaper in cost.

2. No need of external power source.

3. Generally linear scales are adopted

4. Robust and compact designs.

5. Easy to use and understand.

Limitations of mechanical comparators -- **any four limitations ½ mark each**

1. Due to moving parts more wear and tear.

2. Sensitive to shocks and vibrations.

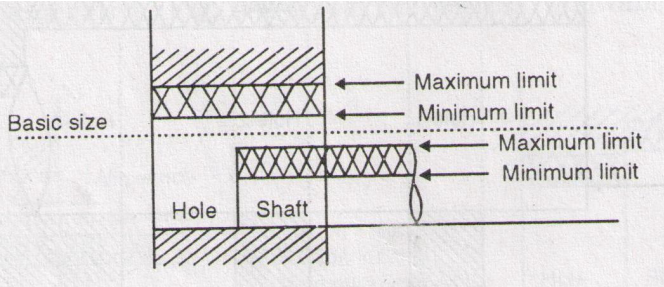
3. Parallax errors are possible.

4. Range of applications is limited.

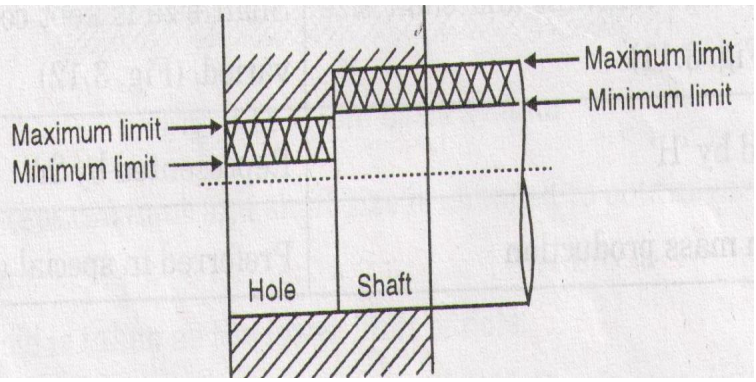
(b)

Clearance or interference is the actual difference in the size of the mating parts.

Maximum Clearance: - The largest permissible shaft diameter is smaller than smallest size of hole.



Minimum Interference:- The minimum permitted diameter of shaft is greater than largest size of the hole



(Definition – 01 mark each, Sketch 01 mark each)

(c)

Line Standard	End standard
Line standard is the standard in which distance is measured between two parallel lines	When the distance is measured between two parallel surfaces it is called as end standard
Accuracy is less	Accuracy is more
Quick and easy to use	Time consuming
Less costly	More costly
Parallax errors	Environmental errors
Manufacturing is simple	Manufacturing is complicated
Application: Steel rule, measuring tape	Application: Slip gauges, End bars

(any four points 01 mark each)

(d)

Screw thread micrometer is similar to the simple outside micrometer. The difference is instead of flat anvils, thread profile anvils are used in screw thread micro meter . The anvils are removable. Anvils are selected depending on type and pitch of thread.

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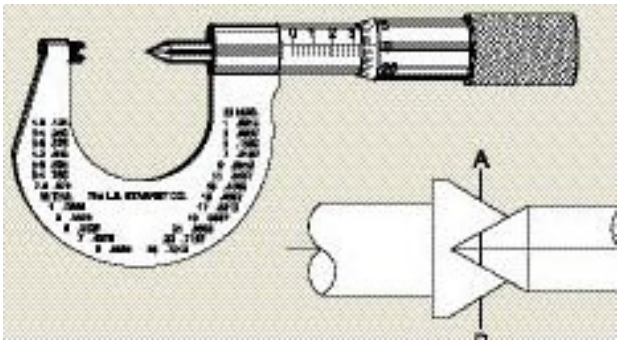
Subject Code:17530 **Model Answer**

Screw thread micrometer is used to measure root diameter and major diameter of threads. The method of finding total reading is same as that of the simple micrometer

Sketch:- 

(**labeled sketch – 03 marks, working principle – 01 mark**)

(e)

Calibration:- The instruments, gauges to be used for measurement should be of known accuracy in order that the results obtained are meaningful. In order to identify the errors and rectification of errors the instruments are compared with masters or standards. This act of comparison is known as calibration.
(Explanation – 02 marks)

Traceability :- Traceability is the property of the results of a measurement, not of an instrument or calibration report or laboratory. Traceability means the result of measurement can be related to a reference through series of calibration reports. **(Explanation – 02 marks)**

(f)

Flaw:- Flaws are irregularities which occur at one place or at infrequent intervals.

Waviness:- Irregularities with large wave length is termed as waviness.

Lay:- lay is the direction of " predominant surface pattern". Lay is mainly decided by the manufacturing process adopted.

Roughness :- Irregularities with small wave length are termed as roughness

(**01 mark for each correct definition as above**)

Q.3

a) (04 marks for explanation, figure not essential but preferred)

Gear tooth vernier caliper is an instrument similar to the ordinary vernier caliper but having a second beam at right angles to the main beam. This additional beam carries a tongue sliding between the jaws, which can be set on the vernier scale so that, when it rests on the top of a tooth, the tips of the jaws are at the correct distance from the tooth flanks for the required measurements.

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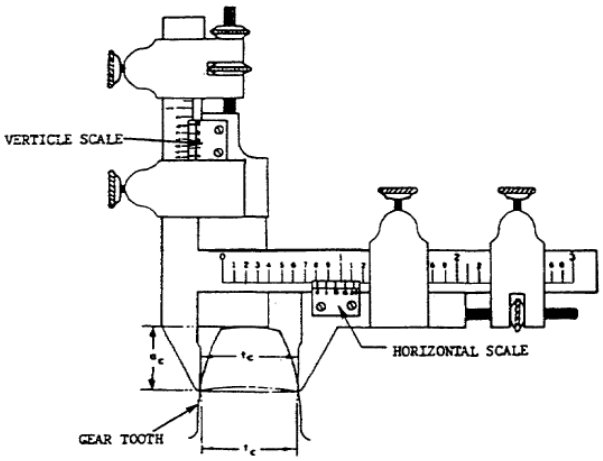
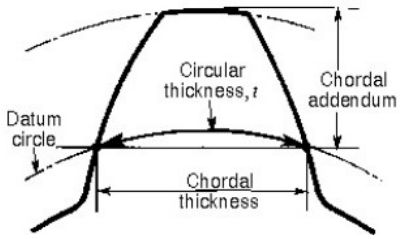
For measuring the chordal thickness, the tongue of the gear tooth vernier is set so that the jaws will touch the flank at the pitch circle. The thickness of the tooth is then measured on the main scale of the instrument.





b)

Acceptance sampling:- **(02 marks each merits and demerits , any two ,one mark each)**

Merits:-

1) Time, money, and labour are saved.
2) Number of inspectors required is less.
3) Less damage to the lot during inspection.
4) If entire lot on inspection is rejected, it is a pressure for quality improvement.
5) The items which are subjected to destructive test must be inspected by sampling inspection only.
6) The problem of monotony and inspector errors induced by 100 % inspection is minimized.

Demerits:-

1) Risk of making wrong decision.
2) The samples usually provide less information about the product.
3) Some extra planning and documentation is necessary.

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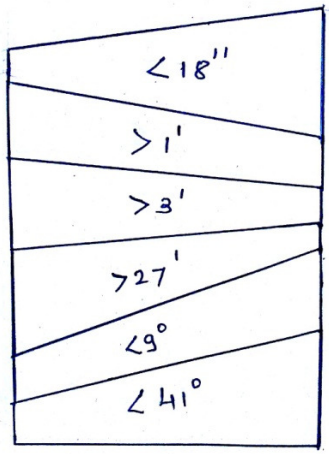
c) **(02 marks for angle calculation, 02 marks for sketch)**

Given angle $49^\circ\ 29'\ 18''$ can be build using following set of angle gauges

$41^\circ + 9^\circ - 27' - 3' - 1' + 18''$

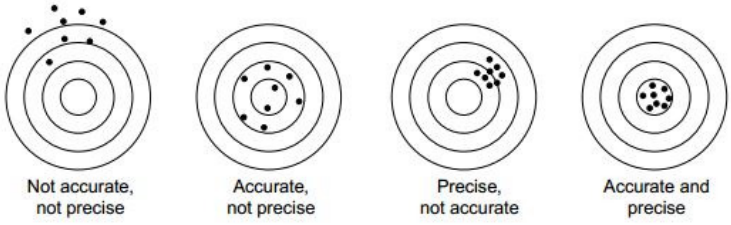
- Minimum no of angle gauges = 06



d) Accuracy and Precision. **(02 marks for difference, 02 marks for sketch)**

Note:- Differentiation using appropriate figure should be given full marks

Accuracy	**Precision**
1. The closeness to the measured value with true value is called accuracy.	1. Repeatability of measuring process is called precision.
2.Costlier to achieve great accuracy	2.Easier and cheaper to achieve precision
3.It is related to true value	3.It is related to average value.
4.Example	4. Example



e) Factors affecting accuracy of measurements:- **(01 mark for each factor any four)**

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Measuring Instrument:- The accuracy of the measurement depends upon the various static and dynamic characteristics of the measuring instruments.(like range, readability, sensitivity, repeatability ect.)

Environmental Conditions: Factors like temperature, pressure and humidity greatly affects on the accuracy of the measurement.

As per the international practices temperature in the test laboratories should be maintained at 20^0c

It is recommended to maintain positive air pressure (10-20 N/m^2).

Calibration of instruments: it is important that any measuring system should be calibrated periodically to get meaningful results

Handling of instruments: measuring instruments must be handled carefully to avoid the errors in measurement and also to save the life of instrument.

Proper method of using an instrument.

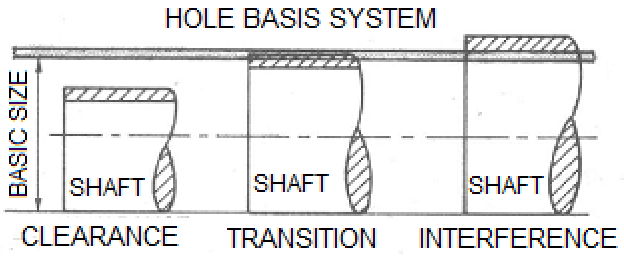
f) Hole basis system:- (01 mark figure, 02 marks explanation, 01 preference)

-In hole basis system the hole dimensions are kept constant and shaft dimensions are varied to get the different clearances and interferences with a single hole whose lower deviation is zero.

- Basic size of the hole is taken as the lower limit of hole.

- The system is denoted by symbol 'H'.

HOLE AND SHAFT BASIS SYSTEM



HOLE BASED SYSTEM
Size of the Hole is kept constant, Shaft size is varied to get different fits

Hole basis system is preferred over the shaft basis system because holes are machined by standard drills or reamers having fixed dimensions, while the shafts can be turned or ground to any given dimension. Hence it is convenient to produce various sizes of shafts than holes of various sizes

Q4 (A)

a)comparison between alignment test and performance test

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Subject Code:17530 **Model Answer**

(01 mark for each difference any 4 points)

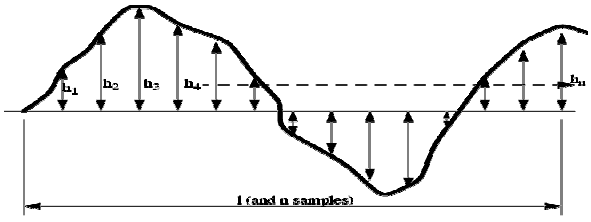
Alignment Test	Performance Test
Various geometrical checks are carried out, called as alignment test	Actual performance of job on machine tool is called performance test
These tests are carried out at static condition	These tests are carried out at working conditions
In this test positions of components and displacement relative to one another are checked.	In this test the jobs manufactured on machine and its tolerance limits as per design are checked.
e.g alignment of axis of lathe spindle to saddle movement.	e.g. manufacturing of job on lathe.

b) (01 mark for each definition, fig. and formulae not essential if written give advantage)

RMS :- it is defined as the square root of the mean of the squares of the ordinates of the surface measured from the mean line.

$$RMS = \sqrt{\frac{h1^2+h2^2+h3^2+\cdots+hn^2}{n}}$$

selected length L is divided into n equal parts h1,h2,h3,h4….., h_n are the heights of selected points 1,2,3,4….. n.



CLA :-it is defined as the average height from a mean line of all ordinates of the surface regardless of the sign.

$$CLA = R_a = \frac{\sum h}{n} = \frac{h_1 + h_2 + \ldots + h_n}{n}$$

Rz:- in this the average difference between the five highest peaks and five deepest valleys within the sampling length, measured from a centre line.

Rz = 1/5 [(R1+R2+R3+R4+R5) – (R6+R7+R8+R9+R10)]

Rq (Geometric average roughness):- Rq is the geometric average height of roughness component irregularities from the mean line, measured within the sampling length.

c) (02 marks sketch, 02 marks labeling)

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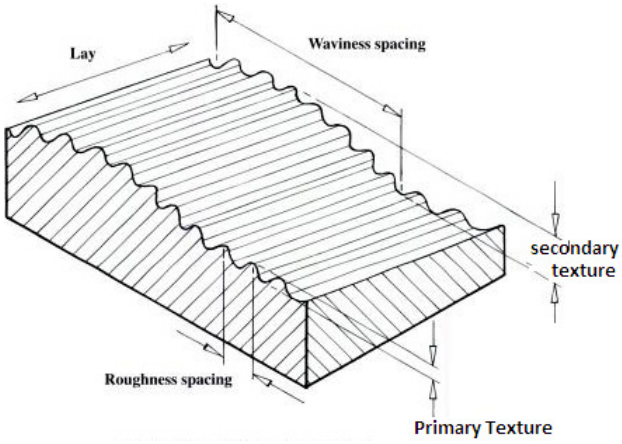

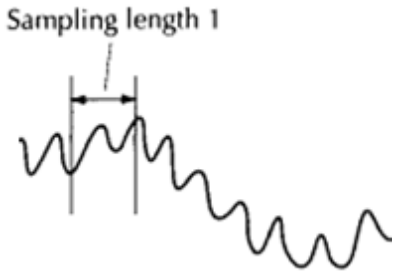

d) **(Define 01 mark, importance 03 marks, any 3 points)**

Interchangeability refers to assembling a number of unit components taken at random from stoke so as to build up a complete assembly without fitting or adjustment.

Importance of interchangeability:-

1) Easy to manufacture.
2) Easy to replace the parts/equipments.
3) Low cost of manufacturing.

Q. 4 (B)

i) **(04 marks for correct explanation)**

Quality Audit:- the quality audit is an appraisal of the quality system of an entire plant.

Quality audit is defined as " A systematic and independent examination to determine whether quality activities and related results confirmed with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives."

- The quality audit evaluates the product, the inspector and the system achieving product quality.

Purpose of audit is:-

- To check whether the system is working properly.
- To know are there defects in the system.
- To know whether identified problems have been corrected.
- To make focus on potential problems.

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The audit may be conducted on a scheduled periodic basis or only when needed by the existence of symptoms of quality problems.

Scope of quality audit:-

Quality audit covers various aspects like

1. Policies and procedures regarding : Operators, Quality control , administration.
2. Operating effectiveness involving: Records, Equipment control, Assessment of product quality.
3. Engineering specifications.
4. System Effectiveness covering: Storage and handling practices, Field complaints and corrective action, Tool and gauge control, product design changes.

Quality audit is one of the key management tools for achieving the objectives set out in the organizations policy.

ii) TQM:- (definition 01 mark 05 marks for explanation any 03 elements)

Definition:-

TQM is the business process and philosophy founded on customer satisfaction and ends with the customer.

TQM refers to the involvement of staff in an organization together which includes suppliers, distributors, and even customers in bringing about quality satisfaction.

Elements of TQM:-

1) Customer satisfaction:- it is the ultimate goal in TQM and thus forms the focal element in TQM. TQM aims at satisfying customer's requirements which never remain constant but keep on changing in times, environment, circumstances, needs, fashion, standard of living etc.
2) Do it right first:- TQM adopts the policy of ZERO defects. There is no scope for rework and rejections. The right first time or zero defect is the result of an emphasis on prevention and use of SPC(statistical process control).
3) Continuous Improvement:- the organization has to cope up with the changing requirements of customers. The TQM strives for ever better quality, cost reduction to face competition and for the survival of the organization.
4) Employee Involvement:- all the persons working in the organization including managers and workers should be involved in TQM operation. A positive attitude towards customer and constant enhancement of quality must be ingrained in the minds of the employees.

5) Empowering the staff.

6) Benchmarking.

7) Feedback mechanism.

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Q 5. (a)

@

$$\bar{\bar{x}} = \frac{\Sigma x}{N} = \frac{20.015}{10} = 2.0015.$$

$$\bar{R} = \frac{\Sigma R}{N} = \frac{0.612}{10} = 0.0612$$

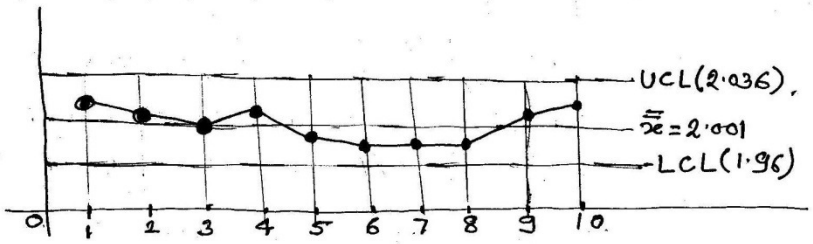
$$UCL\ \bar{\bar{x}} = \bar{\bar{x}} + A_2\bar{R}$$
$$= 2.0015 + 0.577 \times 0.0612$$
$$= 2.036.$$

$$LCL\ \bar{\bar{x}} = \bar{\bar{x}} - A_2\bar{R}$$
$$= 2.0015 - 0.577 \times 0.0612$$
$$= 1.966$$

$$UCL\text{-}R = D_4\bar{R}$$
$$= 2.114 \times 0.0612$$
$$= 0.129$$

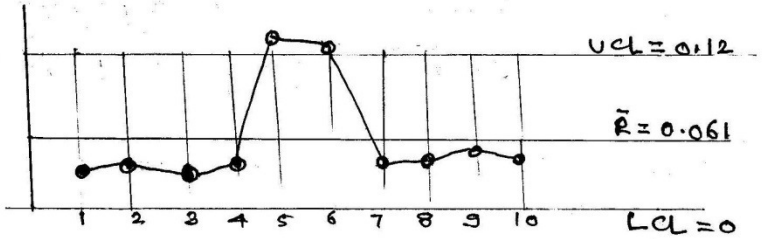
$$LCL\text{-}R = D_3 \times \bar{R}$$
$$= 0$$

$\bar{\bar{x}}$ chart



For $\bar{\bar{x}}$ chart process is in control.

R chart



For R chart process is control but precaution should be taken.

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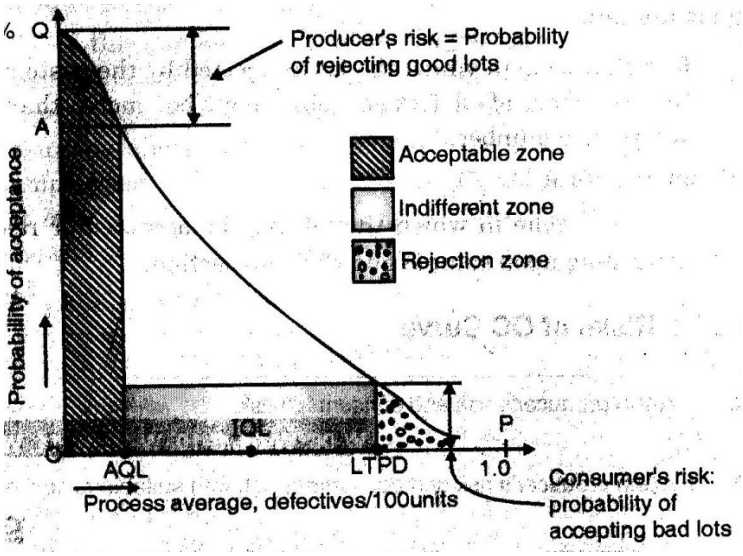
(marks X double bar and R bar-02 , Control limits x chart -01, control limit R chart -01 mark, Graphs 02 marks each with comment)

(b) OC curve for an attribute sampling plan is a graph of fraction defective against - **01 mark**

Probability of acceptance.

Signification of an OC curve: **- 01mark**

1. It compares their performance over a range of possible quality level of submitted product.
2. It provides means of evaluating the sampling plan.
3. It depicts the varying condition of incoming materials.
4. It explains the risks inherent in sampling plan at each level of product quality.



- **02 marks**

Point P: - Probability of acceptance is zero and 100% defective product.

Point Q: - Probability of acceptance is 100% and zero defective product.

A Q L: - Acceptable quality level, probability of acceptance is higher.

IQL: - In difference quality level, probability of acceptance is 50%.

LTPD: - lot tolerance percent defective, rejectable quality level.

Producer risk:- due to sampling plan rejecting good lot.

Consumer risk: - due to sampling plan accepting bad lot. - **04 marks**

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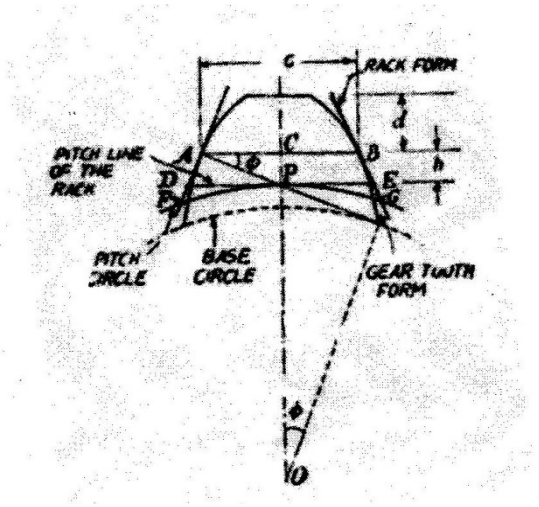
(C)



- **03 marks**

Constant chord of a gear is measured were the tooth flanks touch the flank of the basic rack. The teeth of the rack are straight and inclined to their centre lines at the pressure angle as Shown in fig.

The gear tooth and rack space are in contact in the symmetrical position at the point of contact of the flanks. The chord is constant at this position irrespective of the gear of the system in mesh with the rack. This is the property utilized in the constant chord method of the gear measurement.

The measurement of tooth thickness at constant chord simplified the problem for all number of teeth. Line AB is known as constant chord. The value of C and its depth from the tip d where it occurs can be calculated mathematically and then verified by an instrument.

$$\therefore d = m\left(1 - \frac{\pi}{4}\cos\emptyset\ \sin\emptyset\right.$$

c=AB = constant chord

c=AB = $\pi/2$ m. $\cos^2\emptyset$---------1 MA

- 05 marks

Q 6

1) Effective diameter can be measured by using floating carriage instrument which is more accurate.

2) For measurement of effective diameter two wire methods are used.

3) Two wire methods consist of use of two identical based size of wires.

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4) Fig. shows the measurement of (thread and wire) dimension. The wires of are to be inserted in such a way that

   a. They should be inserted in the same thread and

   b. The flank surfaces are tangent to the wire.

   The dimension of thread wire is indicated by R.

5) fig. shows geometrical sketch with one thread and one wire.

6) Various terms are defined as

   Diameter over wire= R which is measured as shown in fig.

   Diameter under wire = T

   Pitch value = P (it is difference between effective diameter and diameter under wire)

7) From fig it is clear that effective diameter E is addition of diameter under wire and pitch value.

   E= T+P

   E=(R-2d)+P where T=R-2d, E=effective diameter, R= diameter over wire, d= wire diameter, P=pitch value

8) For reducing various types of errors master piece can be used at the time of measurement.

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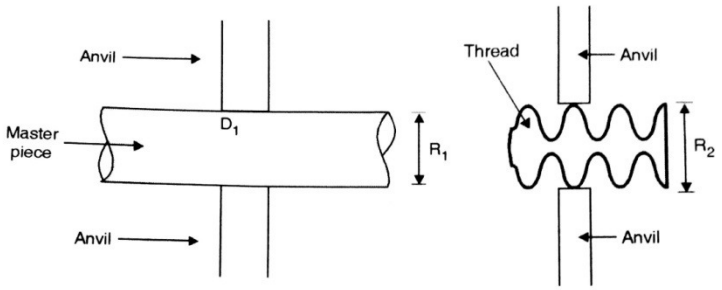
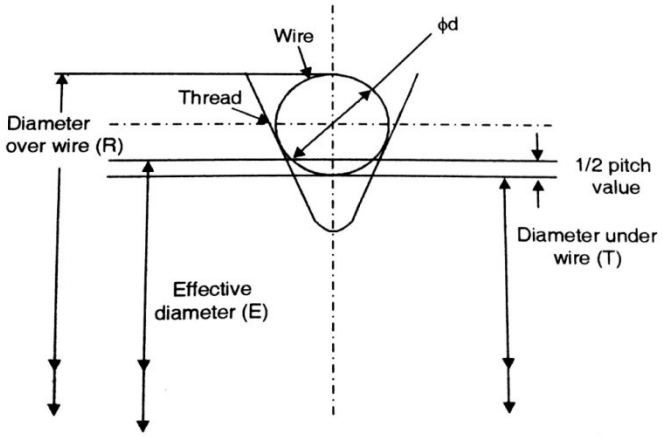


(a) (b)

Fig.



(c)

Fig. Two wire method

(marks description – 05 , Fig -03)

b)

Day	No.of defective magnets	Magnets inspected	% defectives
1	58	721	8.04
2	83	728	11.4
3	70	720	9.7
4	80	730	10.9
5	72	720	10
6	58	700	8.2
7	64	710	9.01
8	78	700	11.14
9	80	710	11.26

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10	84	740	11.35

∑n= 7179 ∑d=727

$\bar{p} = \frac{\sum d}{\sum n} = \frac{727}{7179} = 0.101 = 10\%$ $\quad n = \frac{\sum n}{N} = \frac{7179}{10} = 717.9$

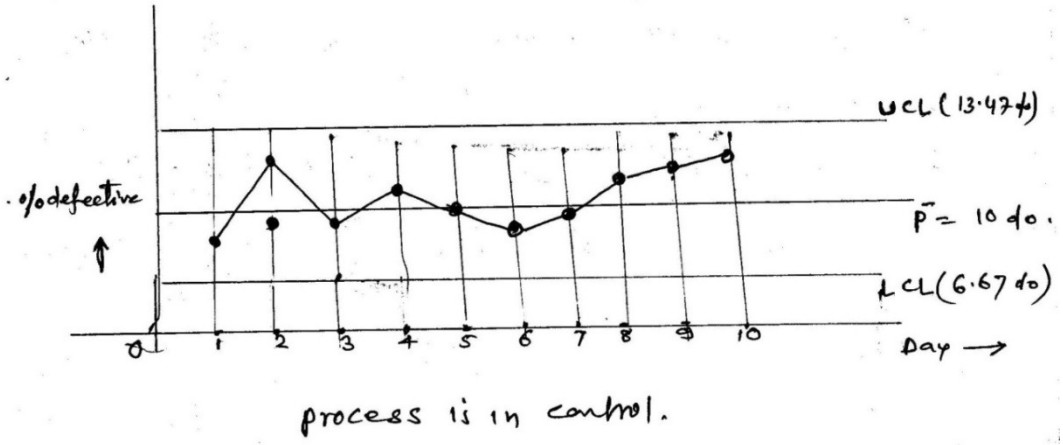
$UCL\ p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$= 0.101 + 3\sqrt{\frac{0.101(1-0.101)}{717.9}}$

$= 0.134 = 13.47\%$

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

$= 0.0673 = 6.73\%$.



process is in control.

(marks P bar -02, control limits -02, graph with comment -04)

(C)

I) process capability is defined as the minimum spread of a specific measurement variation

Which will include 99.7%?

Process capability= 6 σ **-02 marks**

Process capability achieves as follows.

1) Determination of centering of process

2) Determination of position of process compared to tolerance.

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3) Find piece to piece variation

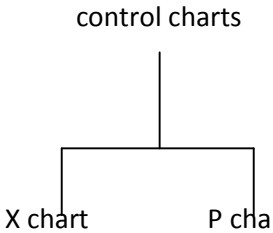
4) Measurement of actual variability

5) Reduction of wastage of production

6) Save money and time. -

02 marks (any 04 points)

ii)



- **02 marks**

NO.	Variable chart	Attribute chart
1	These consider variable data	They take attribute data
2	e.g. size of ball is 24mm	No. of defect in bottle are 02
3	X (bar) chart and R chart	P chart and C chart
4	UCL=X̄+A_2R̄	UCL forC chart C= C(bar) +3 $\sqrt{(\quad)}$

- (02 marks)