WINTER – 12 EXAMINATION

Subject Code: **12157** **Model Answer**

Q.1)a) Attempt any Three

i)Metrology:- "It is a science o f measurement which deals with the measuring instruments, measuring technique and measuring standards". **(1 Mark)**

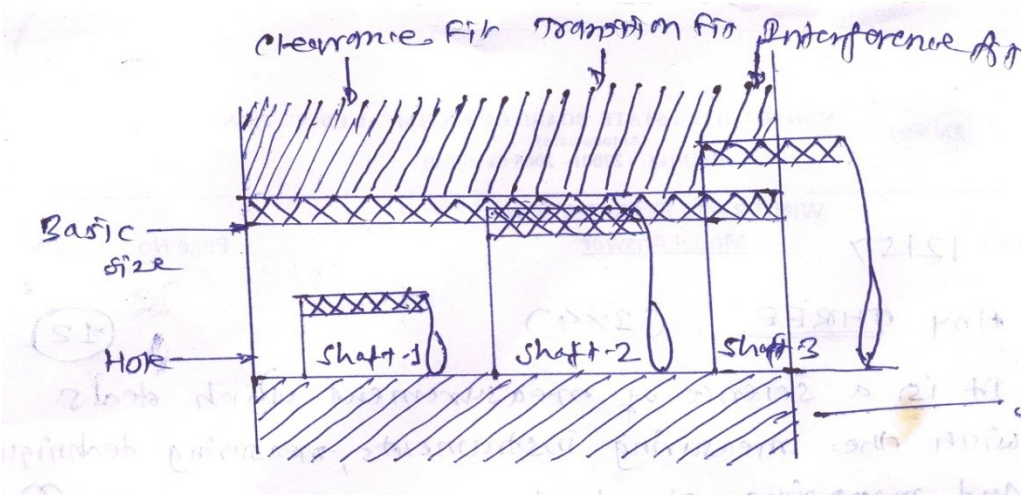
Necessity of Inspection in Industries:-(any three)

1) Quality output
2) Change in technology
3) Mass production
4) Reduce wastage
5) Interchangeability
6) To develop reputation **(1 x 3 = 3 Marks)**

Q.1)a)ii) **(Any four points 1 Mark each)**

Line Standard	End standard
1)The measurement is a distance between two Lines.	1) The measurement is a distance between two surfaces.
2) They are accurate up to ± 0.2mm.	2) They are accurate up to ±0.001mm.
3)Quick and easy	3) Time consuming
4)Less costly	4)more costly
5)Parallax errors can occur	5)Environment errors can occur
6)scale marking & corners	6)Ends are to be protected
7)manufacturing is simple	7) Manufacturing is complex.
8)e.g. Steel rule	8)e.g. Slip gauge

Q.1)a)iii) **(2 Marks for sketch and 2 Marks for explanation)**



Hole basis system

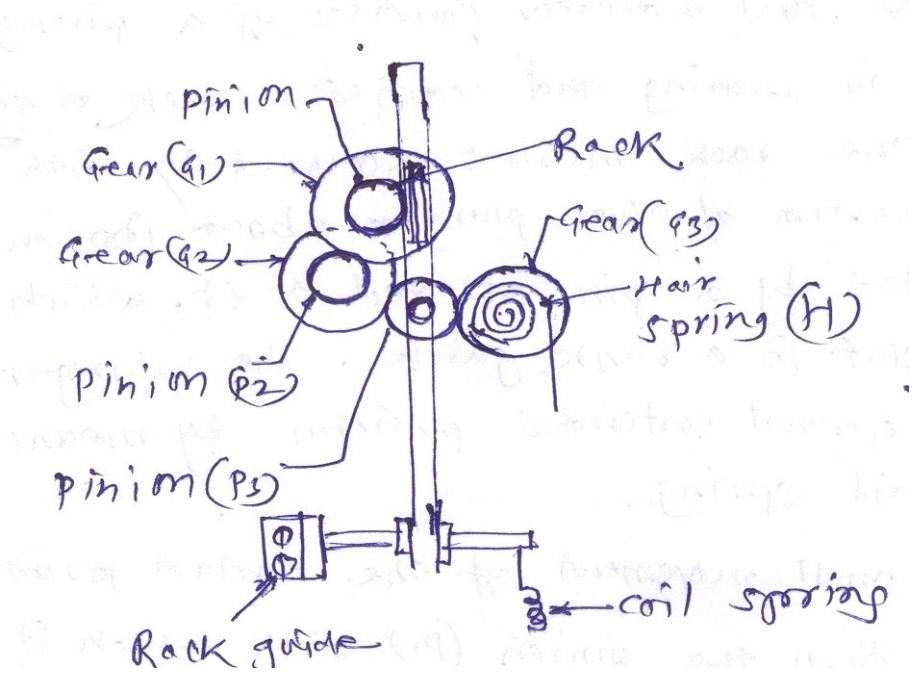
Hole basis system is the system when hole size is kept constant and shaft sizes are varied to obtain various types of fits. Basic Hole is indicated by 'H', where it's lower deviation is Zero.

Q.1)a)iv) **(4 Marks)**

Dimension to be built is 58.975mm. Always Start with the last decimal plane.
Eg.0.005mm & for this 1.005mm slip gauge is selected.
Now dimension left is 58.975-1.005=57.970mm.
Take second decimal place & for it select 1.47mm slip gauge.
Therefore remainder is 57.070-1.47=**56.500mm.**
Next for 56.500mm, we choose 6.500mm piece &
finally 50.000mm piece.
Thus, **50.000+6.500+1.47+1.005=58.975mm**.
All these four slip gauge wrung properly do get required dimension.

Q.1)b) Attempt any one
i) **(2 Marks for sketch 4 Marks for explanation)**

The dial indicator consists of a plunger which slides in bearing and carries a rack at its inner end. The rack meshes accurately with a pinion. The rotation of the plunger about its own axis is prevented by a pin attached to it, which is located in slot in a rank guide. The plunger is kept in its normal extended position by means of a light coil spring.



Construction of Dial indicator

A small movement of the contact point causes the rack to turn the pinion (p_1) with which it is in meshes. A large gear (G_1) is attached to the same spindle as pinion (p_1).The gear further meshes with a pinion (p_1) which thus magnifies the movement of the pinion. A gear (G_2) is attached to the

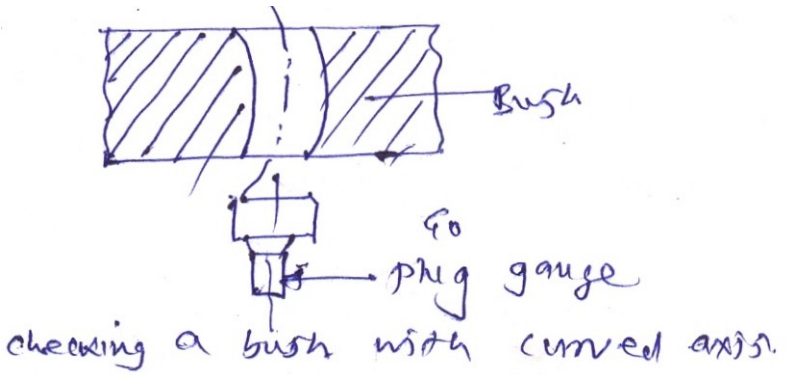
second pinion (p_2).which meshes with pinion (p_3) mounted on the same spindle as in the indicator pointer.
The overall magnification of the final pinion (p_3) is thus

$$\text{Magnification} = \frac{Ng_2 \times Ng_1}{Np_3 \times Np_2}$$

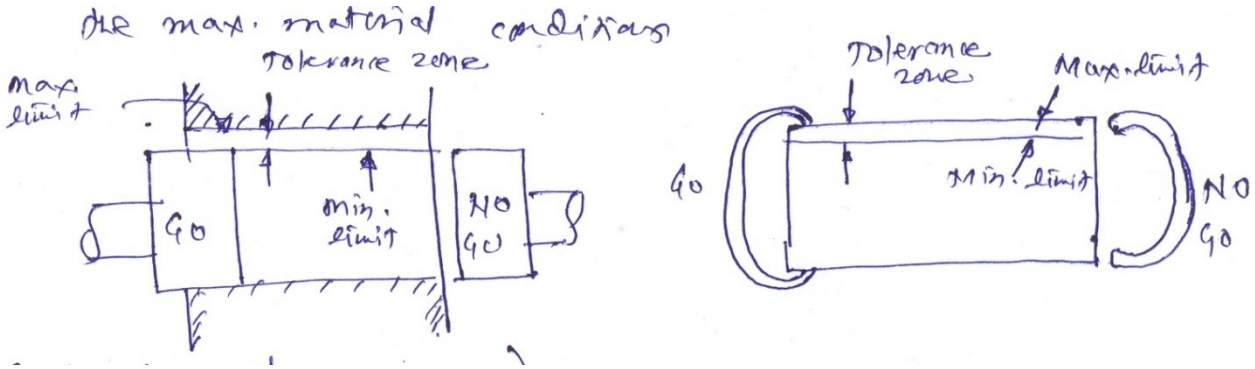
This magnification is further enlarged at the tip of the pointer by an amount depending on the length of the pointer. The overall magnification of any dial gauge may be thus calculated by meaning the distance between divisions the scale & dividing this dimension by the equivalent movement of the measuring plunger. To take up backlash a light hair spring (H) is attached to the gear (G_3) which meshes with pinion p_3.

Q1)b) ii) (2 Marks for sketch and 4 marks for description)

It states that the 'Go' gauge should check all the possible parameters/elements of dimension at a time and the 'No-Go' gauge should check only one element of the dimension at a time.



According to Taylor, 'Go 'and 'No-Go' gauge should be designed to check maximum and minimum material Limits respectively. 'Go limit' is designation applied to that limit of the two limits of size which corresponds to the Max. Material limit considerations. The form of 'Go Gauge' should be such that it can check more than one feature of the component in one pass.



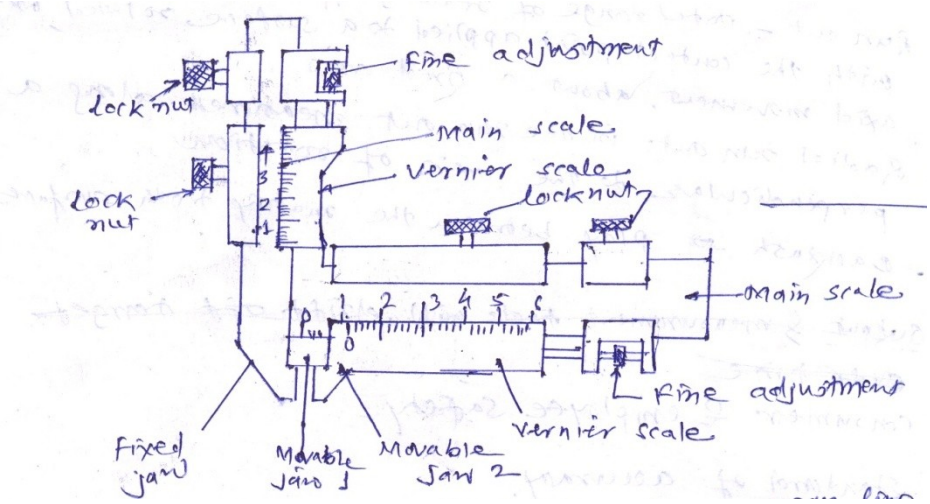
'No-Go limit' is designation applied to that limit of the two limits of size which corresponds to the minimum material conditions.

Q.2 Attempt any four

a) Necessity of calibrating the Measuring Instruments. (Minimum four point 1 Mark each)

1. Standard of accuracy
2. Wearing of measuring faces
3. Stability of instrument over the period of time
4. Remove the errors (deviation from standard)
5. For consumer and employee safety

Q2 b) Type equation here.**(sketch 2 M and procedure 2M)**



Gear tooth Vernier caliper

$$h = \frac{mN}{2}\left(\frac{2}{N} + 1 - \cos\left(\frac{90}{N}\right)\right)$$

-Set height 'h' on vertical vernier by using fine adjustment screw

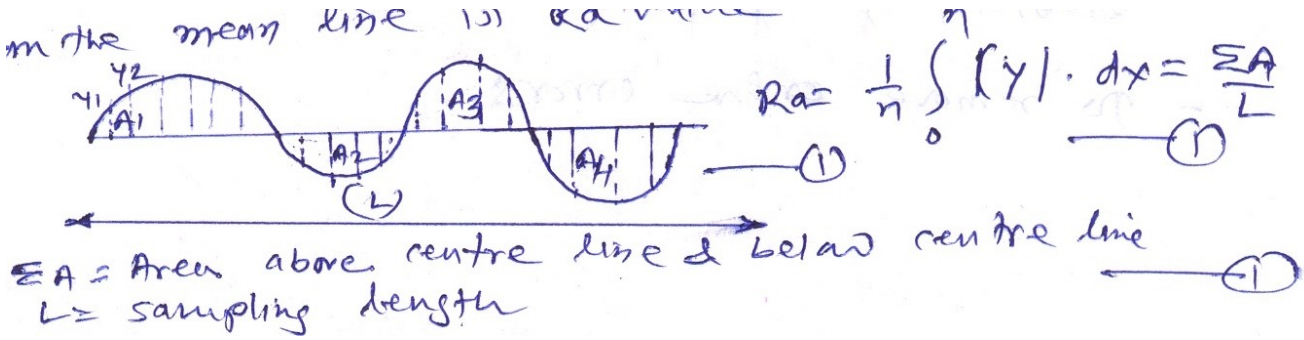
-Apply vernier to gear tooth, so that the fix jaw can touch the flank of tooth, so that the fix jaw can touch the flank to tooth.

-Push movable jaw of horizontal vernier and lock it.

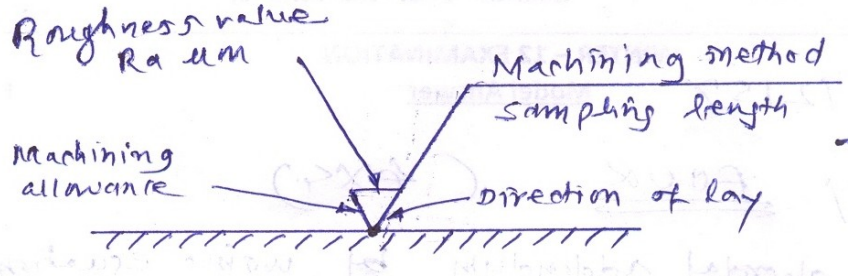
- This gives the gear tooth thickness.

Q 2 c)

Arithmetic mean deviation from the mean line of profile is the average value of the ordinates (y_1, y_2 ….y_n) from the mean line is Ra value. **(1 Mark)**



Q 2 d) **(4 marks)**



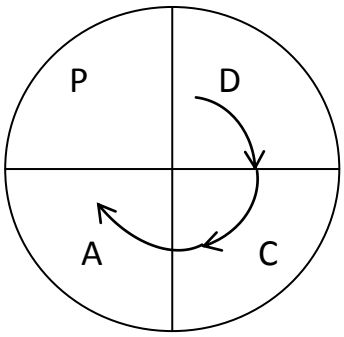
Q 2 e) **(List 1 M and explanation of any three 3 Marks)**

Profile, spacing, pitch, Run-out, Gear tooth, Lead, Backlash.

- Cumulative Pitch Error:- Actual length between corresponding flanks of teeth not adjacent to each other
- Tooth Thickness Error :- Difference in actual tooth thickness and required tooth thickness.
- Cyclic Error: - It is occurring during each revolution of the element under consideration.
- Run out:- Total range of reading of a fixed indicator with the contact point is applied t a surface rotated, without axis movement, about a fixed axis.
- Radial run out is the run out measured along a perpendicular to the axis of rotation.
- Backlash: - Play between the mating tooth surfaces.

Q 3. Solve Any Four (4x4)

a) Plan-Do-Check-Act for implementation of TQM in any of the organization. (sketch 1 M explanation 3M)



PLAN:- i) Lay down and plan policies and the objectives of TQM
ii) Plan method to achieve the objective of the organization

DO: - iii) Provide education and training to workers and managers to achieve objectives.
iv) Implements TQM by introduction newer things

CHECK: - v) Check the results by observing them and find cause of the non conformance.
vi) Analyze the results.

ACT: - vii) Try to act for the preventing undesired effects.

viii) Measure the improvements and design for the future.

b) (any four 4 Marks)

- To identify exact customer requirement.
- To deliver low level of error and defect that perfection close to zero defects.
- Determination of centering of process
- Determination of position of process compared to tolerance
- Find piece to piece variations
- Measurement of actual variability
- Reduction of wastage of production
- Save money and time.
- To measure the ability of the process to meet the specified tolerance

c) Procedure of problem solving using quality circle (4 Marks)

- Problem identification: - The members have to identify various problems that one to be solved.
- Problem selection:- The members then decides the priority and selects the problem that they would like to solve first.
- Problem analysis:- Then the problem is classified and analyzed by basic problem solving techniques like brain storming, Pareto analysis etc.
- Generation of alternative solution:-By knowing various causes, it could be possible to generate various alternative solutions.
- Select the most appropriate solution:- The members goes for analysis of the various solutions related to cost, possibility of implementation etc.
- Prepare action plan:- Members prepare action plan related to the solution implemented like place of implementation, date, time etc.
- Presenting solution of management:- The circle members presents solution to the management for approval.
- Implementation of Solution:- Management evaluated the solution and testing can be done before implementation, if possible.

d)

i) Primary Texture (2 Marks)

These are irregularities of small wavelengths.

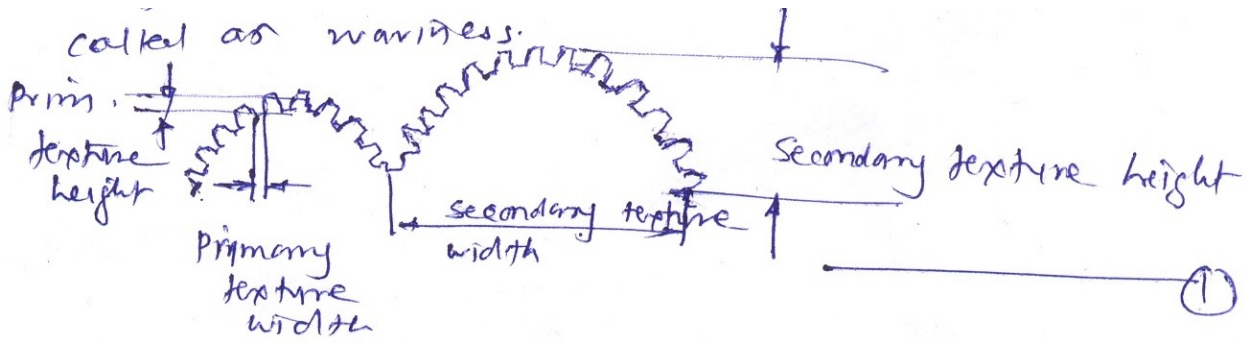
These are cause due to:- Direct action of cutting tool, friction wear, corrosion, tool feed rate.

These are called as roughness.

ii) Secondary Texture: (2 Marks)

These are irregularities of considerable wavelength

These are caused due to disturbance in set up, misalignment of centres, lack of straightness in guide ways, non linear feed motion. These are called as waviness.



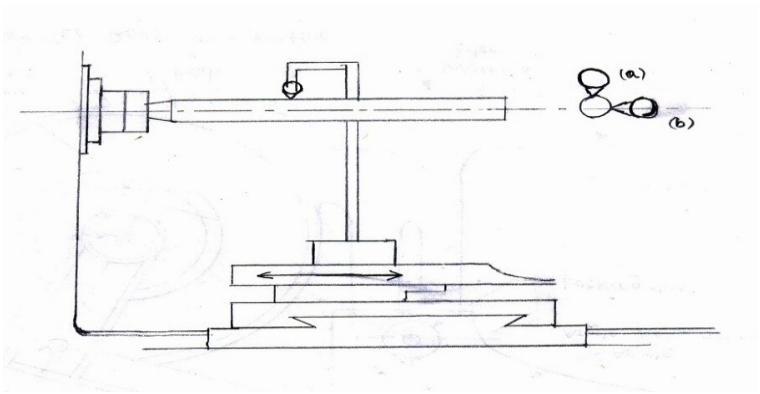
e) **(1 Mark each)**

100 % Inspection	Sampling Inspection
Time required is more	Time required for sampling inspection is less
Large no. of staff is required	Less staff or inspection is required
Damage to products because of more handling	Less damage to products because lesser handling
Cost is more	Cost is less

Q.4ai) Difference between alignment and performance test **(4 Marks)**

Alignment Tests	Performance Tests
It is a geometric test	It is a practical test
These tests include checking of dimensions of forms and positions of components as well as checking of their displacement relative to one another.	These tests include the machining of test pieces appropriate to the fundamental purposes for which the machine has been designed.
Main spindle is tested for eccentricity, axial slip, accuracy of axis and position relative to other axes and surfaces.	It reveals the alignment accuracy of the machine tools under dynamic loading.
e.g. straightness, flatness, parallelism, squareness, rotation etc.	e. g. tolerances, surface finish

Q. 4a ii) **(sketch 1 Mark and explanation 3 M)**



Parallelism testing of lathe axis with lathe bed.

We require to check in a) Vertical plane b) Horizontal plane.

Measuring instruments:- Test mandrel with taper shank or 300 mm long cylindrical measuring part and dial gauge.

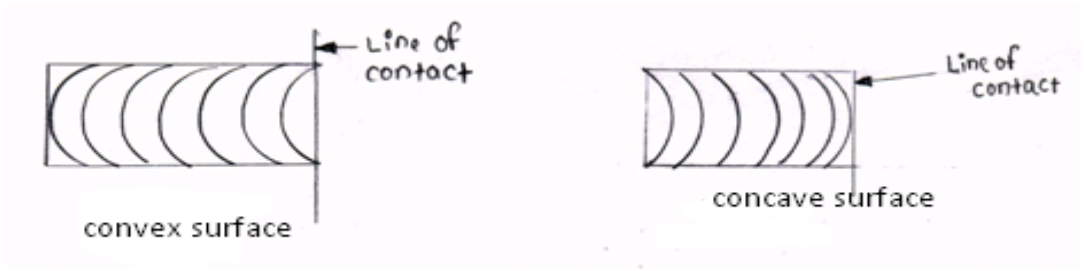
Procedure:- The dial gauge is mounted on the saddle. The dial gauge spindle is made to touch the mandrel and the saddle is moved to and fro. It is checked in vertical as well as in horizontal plane.

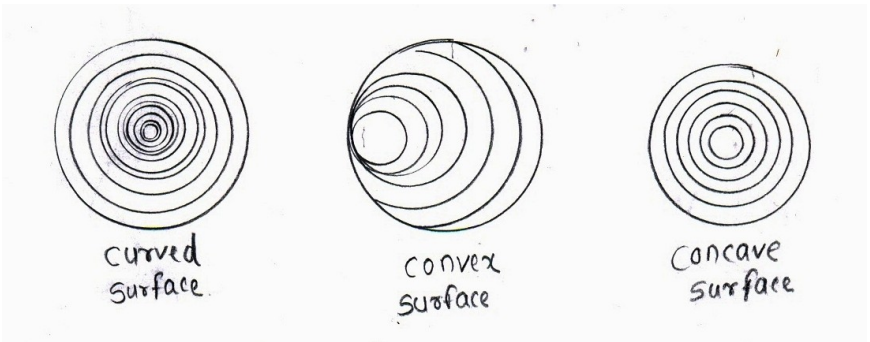
Permissible errors :- a) 0.02/300 mm mandrel rising towards free end only.

b) 0.02/300 mm mandrel inclined at free end towards tool pressure only.

Q 4a iii) (sketch 1 Mark and explanation 3 M)

When an optical flat is place on the surface to be test and illuminated by the monochromatic light, the alternate dark and bright bands are observed. These are produced by the interference of light rays reflected from bottom face of the optical flat and top surface of the test piece through a very thin layer of air entrapped between the surfaces. If the surface under test is perfectly flat, then there will not be change in the fringe pattern. If the surface is not flat then band obtained will be curved. If the bands curve around the point or line of contact, the surface is **convex surface** and if the bands curve in opposite direction, then the surface is **concave surface.** If the curvature of bands is more it indicates more convexity and vice – versa





When the surface under test is curved, circular bands with a central bright spot at the point of contact are observed. To determine whether the surface is concave or convex, it is pressed lightly with finger tip at one edge. If the centre of the bands is displaced and the fringes come closer, the surface under test is convex. If the application of light pressure at edge makes no change, then light pressure is applied at the centre. If the bands move apart and number of bands is reduced, the surface to be tested in concave.

Q4a iv)

Quality of conformance:- (1 Mark)

"The quality of conformance is the concerned with how well the manufactured Product conforms to the quality of design".

When a design has been established, it is the task of all responsible for production planning and manufacturing to obtain a high level of quality of conformity; the measure of truthfulness with which the product conforms to the design specifications.

Factor controlling Quality of conformance:- (Any three factors 1 Mark each)

1) The incoming raw materials are of the adequate quality. The machines and tools for job and the measuring instruments are adequate for their purposes and are kept at high level of maintenance.
2) Proper selection of the process and adequate process control.
3) The operators should be well trained, experienced and motivated for quality consciousness.
4) Proper care should take in shipment and storage of finished goods.
5) Inspection programme is such that it gives accurate measure of the efficiency of the whole system, and ensures to reduce and sort out defective products from the lot during processing.
6) Feedback from both, the internal inspection and the customers, are obtained regarding quality for taking corrective action.
7) SQC techniques should be used to control variability in manufacturing process.
8) Higher quality of design usually costs more, higher quality of conformance usually costs less, by reducing the number of defective products produced.

Q.4b)i) **(3 Marks each)**

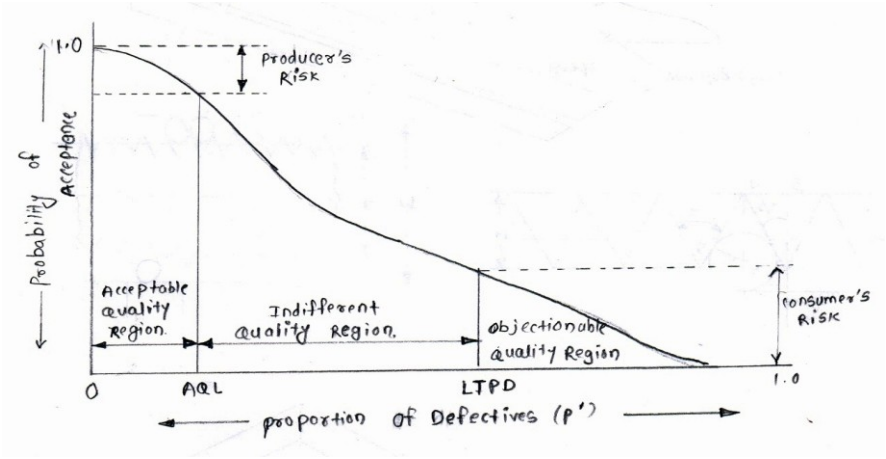
Touch inspection:-

In this method, the figure tip is moved along the surface at a speed of about 25 mm per second and the Irregularities as small as 0.01 mm can be easily detected. This method can assess which surface is more rough, it cannot give the degree of surface roughness. Also the minute flaws can't be detected. A modification of it is possible by using a table tennis ball, which is rubbed over the surface and vibration from the ball transmitted to hand and surface roughness judged thereby.

Scratch inspection:-

In this method, a softer material like lead, babbit or plastic is rubbed over the Surface to be inspected. By doing so it carries the impression of the scratches on the surface which can be easily visualized.

Q.4b)ii) **(2 Marks sketch, 2 Marks for each explanation)**



O.C. Curve

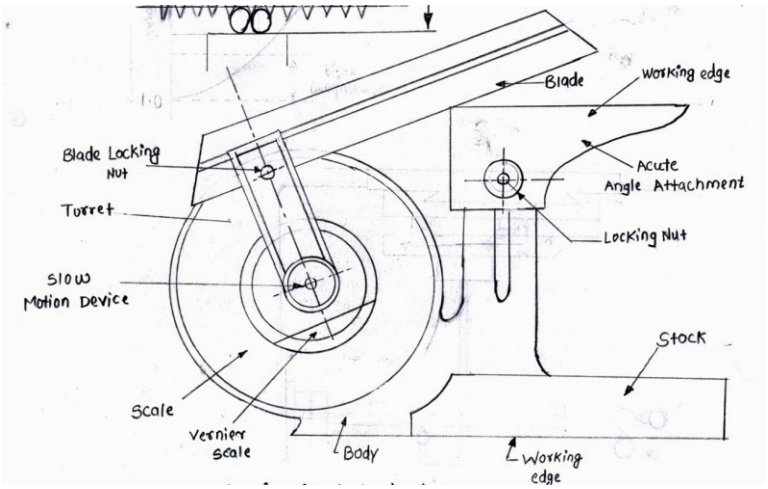
1)Producer's risk:-

Since ideal sampling plan which will satisfy both the consumers and producer is not possible, some compromise has to be made and they have to tolerate certain risk. If the quality is good still from sampling plan some lots are rejected the producer has to suffer. The producer's risk is "the probability of rejection a good lots which otherwise would have been accepted". So the producer should be protected against the rejection of relatively better products .The producer can decrease the risk By producing product at better quality level than the specified AQL depending on other economical considerations.

2)consumer's risk:-

If the quality is bad still from the sampling plan some lot are to be accepted the consumer will suffer. Consumer's risk is "the probability of defective lots being accepted which otherwise would have been rejected".

Q 5 a) Procedure for measuring "Angle of Work piece" (3 Marks sketch, 5 Marks for explanation)



Universal bevel protractor

The working edge of the bevel protractor is placed on the surface plate and the blade is placed/aligned on the surface of the work piece of which angle is to be measured. The reading of main scale and vernier scale is noted down. When work piece is small in size, the workpiece may be place on the working edge of the acute angle attachment. By aligning the blade to another surface we can measure the angle of the work piece.

Q.5)b (i) **(2 marks each)**

Measuring Instruments For Measuring Internal and External Threads:-

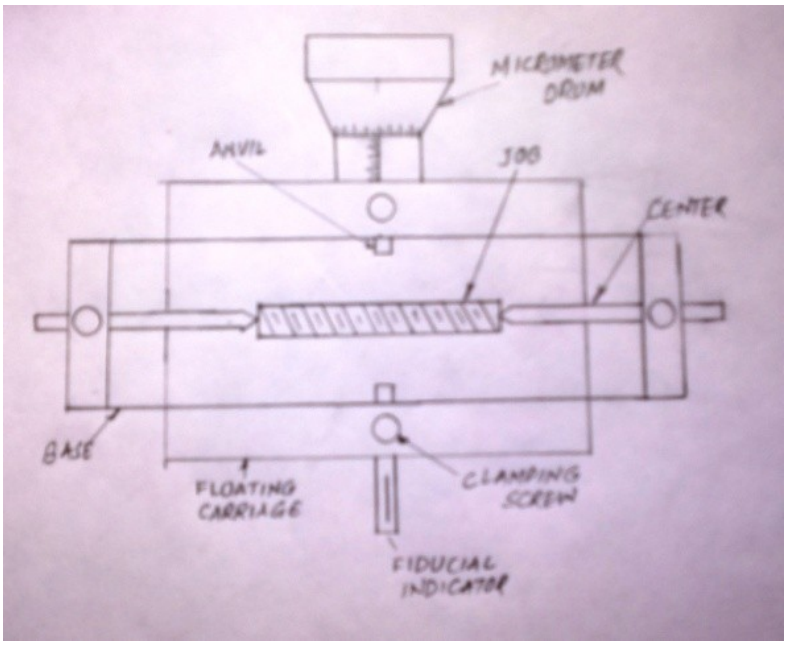
For External threads:

Micrometer with V-piece
Thread micrometer
Floating carriage micrometer
Pitch measuring machine
Profile projector
Tool maker's Microscope.

For Internal Threads:

Taper parallels
Rollers and slip gauges
Horizontal comparator fitted with detachable small ball ended styli.
Pitch measuring machine

Q.5)b (ii) **(2 Marks sketch, 2 Marks for explanation)**



Working principle of Floating Carriage Micrometer.

Floating carriage micrometer consists of two pillars. One consists of the fiducial indicator and other with micrometer drum. This is called floating carriage because both the anvils on the pillars are not aligned in the same line. The X and Y direction is given to the pillar to adjust on the wire and threads. The diameter of the micrometer drum is increased so that periphery of the drum can be divided in more divisions to obtain the more accurate measurement.

Q.5)c

Advantages of ISO-9000: **(4 Marks)**

1. Motivate exporters
2. Pressure on work force to rectify and meet customer commitment
3. Set baseline
4. Independent audit and management reviews provide better communication.
5. Establishes reasonable standard for Government procurement.
6. Focuses training and professional development
7. Improves the company's quality image
8. Improves efficiency: reduce scrap and reworked
9. Gives marketing advantage.

Limitation of ISO-9000:- **(4 Marks)**

1. The implementation of a formal quality system is very demanding or resources
2. It is time consuming
3. It may involve considerable secretarial expense
4. Assignment and registration are costly
5. It needs to change attitude and accept new working practice may strain the management capability of the company beyond its ability to cope.

Q 6 a) **(8 Marks)**

$\bar{\bar{x}} = \frac{\sum \bar{x}}{N} = \frac{598.4}{10}$ (1m)

$\bar{R} = \frac{18}{10}$ (1m)

$UCL_{\bar{x}} = \bar{\bar{x}} + A_2 \bar{R}$
$= 59.84+0.577x1.8$
$= 59.84+1.0386$
$= 60.87$

$LCL_{\bar{x}} = \bar{\bar{x}} - A_2 \bar{R}$
$= 59.84 - 0.577x1.8$
$= 59.84 - 1.0386$
$= 58.80$ (2m)

$UCL_R = D_4 \bar{R}$
$=2.11 \times 1.8$
$= 3.7$

$LCL_R = D_3 \bar{R}$
$=0 \times 1.8$
$= 0$ (2m)

The specification limits for components
Higher Limit = 62.5, and
Lower Limit = 55.5
Where, higher and lower limit of control charts are 60.87 and 58.8 respectively.
So, product will be able to meet specifications. (2m)

6 b) **(8 Marks)**

Sr. No.	No. of defectives	Fraction defectives	Sr. No.	No. of defectives	Fraction defectives
1	48	0.064	11	29	0.0387
2	83	0.111	12	51	0.0680
3	70	0.093	13	29	0.0387
4	85	0.113	14	31	0.0413
5	90	0.120	15	37	0.0493
6	56	0.075	16	80	0.1067
7	51	0.068	17	70	0.0933
8	71	0.095	18	48	0.0640
9	36	0.048	19	67	0.0893
10	50	0.067	20	57	0.0760
	640			499	
	N=	1139		n = 750	

$$\bar{p} = \frac{Total\ Number\ of\ defectives}{Total\ number\ of\ items\ inspected}$$

$$= \frac{1139}{20*750}$$

$\bar{p} = 0.0759$

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

$$= \bar{p} + 3\sqrt{\frac{0.0759\ (1-0.0759)}{750}}$$

$= .0759 + 0.029$

$UCL\bar{p} = 0.1049$

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

$$= \bar{p} - 3\sqrt{\frac{0.0759\ (1-0.0759)}{750}}$$

$LCL\bar{p} = 0.0469$

Upper control limit and lower control limit for p chart is 0.1049 and 0.0496 respectively. Fraction defective of Lot no 2, 4, 5 and 16 are on upper side of $UCL\bar{p}$ and others are well below it. Reasons for only these point could be analyzed and eliminated and then it can be said that the process is in control.

Q.6)c)i)

Importance of process capability study in solving quality problems (any 4 points 4 Marks)

1. Measuring process capability to find out whether the process is inherently capable of meeting the specified tolerance limit.
2. Discovering why a process capable of is failing to meet specifications.
3. By knowing the capability of the process and available equipment, has a more rational basis while setting the specifications.

4. The job with more rigid tolerances can be assign on the more capable machines.
5. Tooling improvement can be done
6. The capability information helps to decide which machine may require overhaul
7. The data helps to decide which machine need the closest watching in production.

Q.6)c)ii)

Statistical quality control (S.Q.C):- **(1 Mark)**

A Quality control system inspection, testing and analysis to ensure that quality of the product produced is as per the laid down quality standards.

SQC involves analysis of the characteristics of a production output by inference from sampling the output.

Statistical quality control is systematic as compared to guess-work of haphazard process inspection, and the mathematical statistical approach neutralizes personal bias and uncovers poor judgment.

Objectives of S.Q.C:- **(any three 3 Marks)**

1) Better quality/cost ratio
2) Reduction of Scrap and rework
3) Better inspection
4) Adherence to specifications
5) Reduces wasted machine and man hours
6) Better customer relation through general improvement of product.

----------x----------x----------x----------