Factors effecting surface roughness :-

- → By vibrations
- → Material of the work piece [doesn't deform it's shape → rigidity]
- → Type of machining
- → rigidity of the system consists of machine tool, fixture cutting tool
- → Type, form, material and sharpness of the cutting tool
- → cutting conditions i.e feed, speed & depth of cut
- → The type of coolant used.

"What are the reasons for controlling surface texture" :-

- → To improve the surface life of component
- → To improve the fatigue resistance
- → To reduce initial wear of parts
- → To have a close dimensional Tolerance on the parts.
- → To reduce frictional wear
- → To reduce Corrosion by minimizing depth of irregularities
- → For good appearance
- →

"Wt are the orders of geometrical irregularities"

1) First order

The irregularities caused by inaccuracies in the machine tool it self are called as first order irregularities These includes

a) lack of staightness of guide ways on which the tool must move

b) surface irregularities due to deformation of work under the action of cutting forces

c) Due to the weight of material it self

2) second order

The irregularities cause due to vibrations of any kind are called second order irregularities, The includes

Chatter marks on the surface of the parts

3) Third order

If the machines are perfect and completely free from vibrations. Some irregularites are caused by machineing it-self due to the characteristics of the process These includes

feed mark of the cutting tool.

4) fourth order

The fourth order irregularities include those arising from the rupture of the material during the separation of the chip.

→ The irregularities on the surface of the part produce can also be grouped in to two parts

(i) Roughness (or) primary texture

(ii) Waviness (or) secondary texture

Distinguish primary texture and secondary texture

primary Texture	secondary Texture
→ The surface irregularities of small wavelength are called as primary texture (or) roughness	→ The surface irregularities of considerable wavelength of a periodic character are called secondary Texture
→ These are caused by direct action of cutting elements on the material like tool feed rate, tool shape (or) some other distrubences such as friction, wear or corrosion	→ These irregularities are ~~include~~ ~~and~~ cause due to inaccuracy of slides, wear of guides, missalignment of centers, non linear feed rate, vibrations of any kind

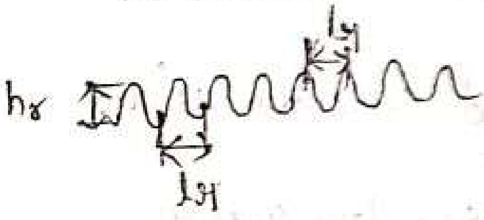
→ The include 3rd and 4th order irregularities and constitute the micro geometrical errors.

→ These errors include 1st and 2nd order irregularities and constitute macro geometrical errors.

→ The ratio $\frac{l_r}{h_r} < 50$

where l_r – length along the surface

h_r – deviation of surface from the Idle one.

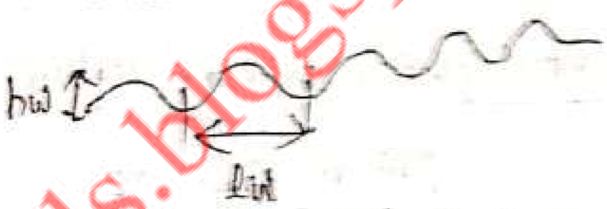


→ The ratio of $\frac{l_w}{h_w} > 50$

Where,

l_w – length along the surface

h_w – deviation of surface from Idle one



→ It is also called Roughness

→ It is also called Waviness

Explain the form of surface texture :-

a) surface – the surface of a part is confined by the boundary which separates that part from another part of substance/space.

b) Actual surface – this refers to the surface of part which is actually obtain after a manufacturing process

c) Nominal surface – It is a theoretical, geometrical perfect shaped surface which doesn't exist in pratice but is an average of the irregularities that are super imposed on it.

d) profile – It is defined as contour of any section through a surface

Evaluation

~~Evalution~~ of surface roughness:-

A numerical assesment of surface finish can be carried out in a number of ways

These Numerical values are obtain with respect to a datum

The following Three methods are used for evaluating the primary texture.

a) Average roughness
b) ~~Peak~~ to ~~valid~~ valley ~~type~~ meth peak to valley height method
c) form factor method (or) Bearing curve

(a) Average Roughness :- This method is a statistical method and the following three methods are used for evaluating the avg. roughness.

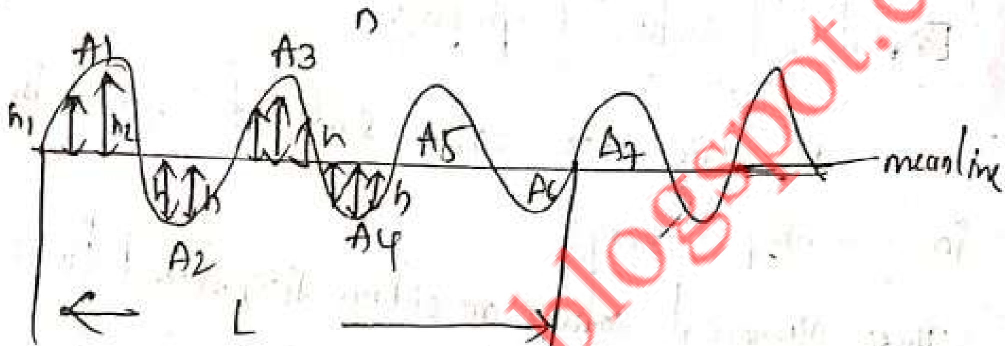
i) CLA method :- it stands for 'centre line average' (or) arithematic average.

It is defined as the average values of ordinates from the mean line regardless of the arthematic ~~sig~~ ~~scheme~~ signs.

$$CLA = \frac{A_1 + A_2 + A_3 + \cdots}{L}$$

(or)

$$CLA = \frac{h_1 + h_2 + h_3 + \cdots h_n}{n}$$



the planimeter is used for finding out the areas

CLA value measure is prefered over RMS. Since the value of the area is measured using planimeter.

ii) RMS method :- It stands for Root mean square method

This method is based on least squares the roughness is measured as the average deviation from the nominal surface

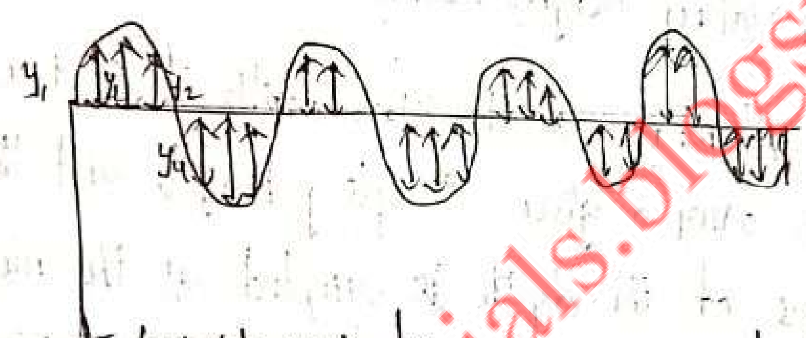
RMS value is defined as square root of arthematic mean of the values of the squares of the ordinates of the surface measured from a mean line.

It is obtained by setting many equidistance ordinate on the mean line i.e $y_1 + y_2 + y_3 - \cdots y_n$ and when taking the root of the mean of the squared ordinates

let us assume that the sample length 'L' is divided into 'n' equal parts and $y_1, y_2, y_3 \dots y_n$ are the heights of the ordinates ~~are~~ ~~cate~~ erected at those points then

$$Rms = \sqrt{\frac{y_1^2 + y_2^2 + y_3^2 + \dots y_n^2}{n}}$$

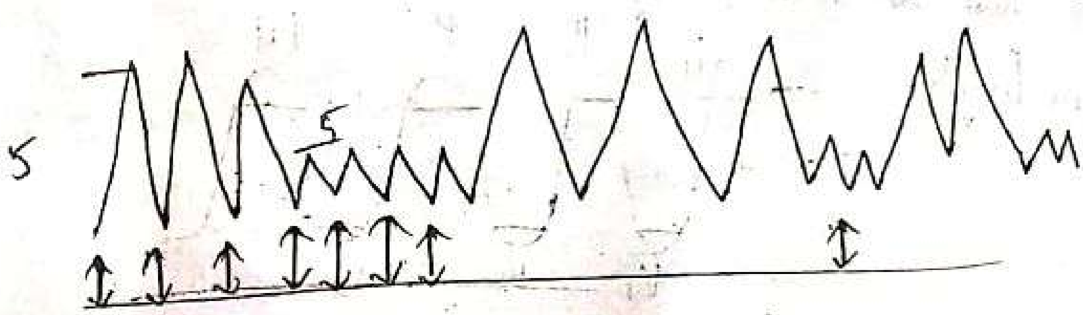
$$y_{RMS} = \left[\frac{1}{L}\int_0^L y^2 \, dL\right]^{1/2}$$



(iii) Ten point height method:- In this method the average diff. between the five heighest peaks and five lowest valleys of surface texture with in the sampling lengths measured from a line parallel to the mean line and not crossing the profile is used to denote the amount of surface roughness.

mathematically it is represented R_Z

$$R_Z = \frac{1}{5}\left[[y_1+y_2+y_3+y_4+y_5] - [y_6+y_7+y_8+y_9+y_{10}]\right]$$



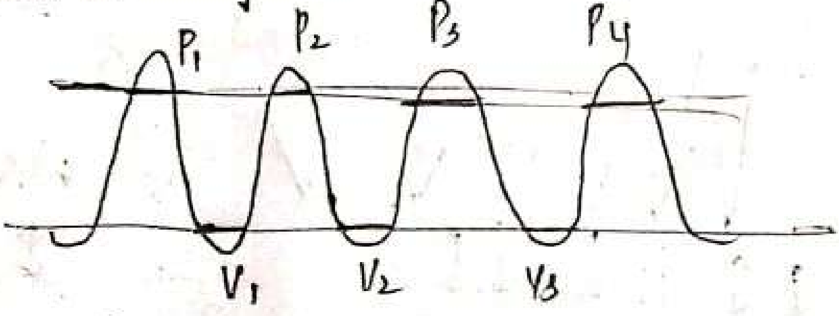
This method is mostly simple method of analysis and measures the total depth of the surface irregularities with in the sampling lengths. but, it doesn't give sufficient information about the surface as no account is taken of frequency of the irregularities. and the profile shape.

This method is used to control the cost of finishing for checking the rough machining.

(b) peak to valley hight method:-

It measures the Maxi. depth of surface roughness irregularities over a given sampling length and the largest value of the depth is accepted as the measure of roughness

the draw back of this method is That it may have same value of h_{max} for two different surface texture inorder to overcome the drawback. peak to valley hight is defined as the distance b/w a pair of ~~hight~~ lines running parallel to the general lay of the ~~cen~~ Trace position so that the length lying with in the peaks at the top is 5% of ~~Samp~~ Trace length and that within the valleys at the bottom is 10% of the Trace length



(c) Form factor and bearing curve:

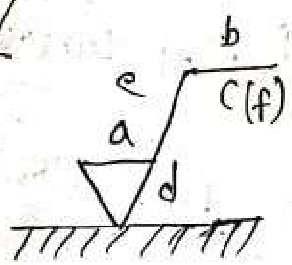
The load carrying area of every surface is often much less than mightly thought. This is shown by reference to form factor

The form factor is obtained by measuring the area of the material above the randomly choosen base line in the section and the area of the envelop rectangle therefore the degree of fullness $K = \frac{\text{Area of the metal}}{\text{Area of the rectangle}}$

degree of emptyness $K_p = 1 - K$.

bearing area curve :- it is also called abbots bearing curve. It is determined by adding the lengths a, b, c --- at depth x, y, z below the reference line and indicates the percentage area of bearing which becomes available as the crest area worn away

ISI indication of surface roughness :-



a - Roughness value in micrometers
(or)
Roughness grade [N_1 to N_{12}]

b - the production method, Treatment. or coating

c - The sampling length

d = direction of lay

f – other roughness values

e – machining allowance

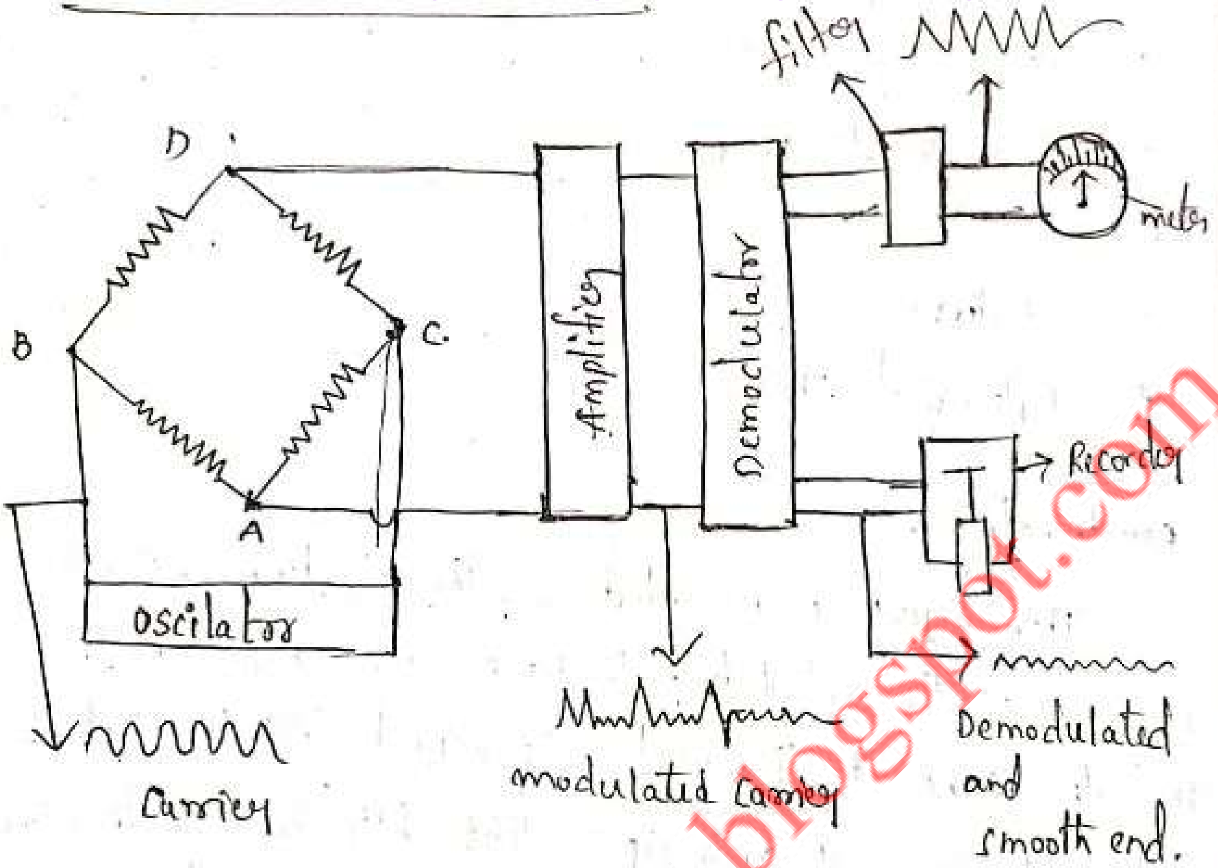
①.

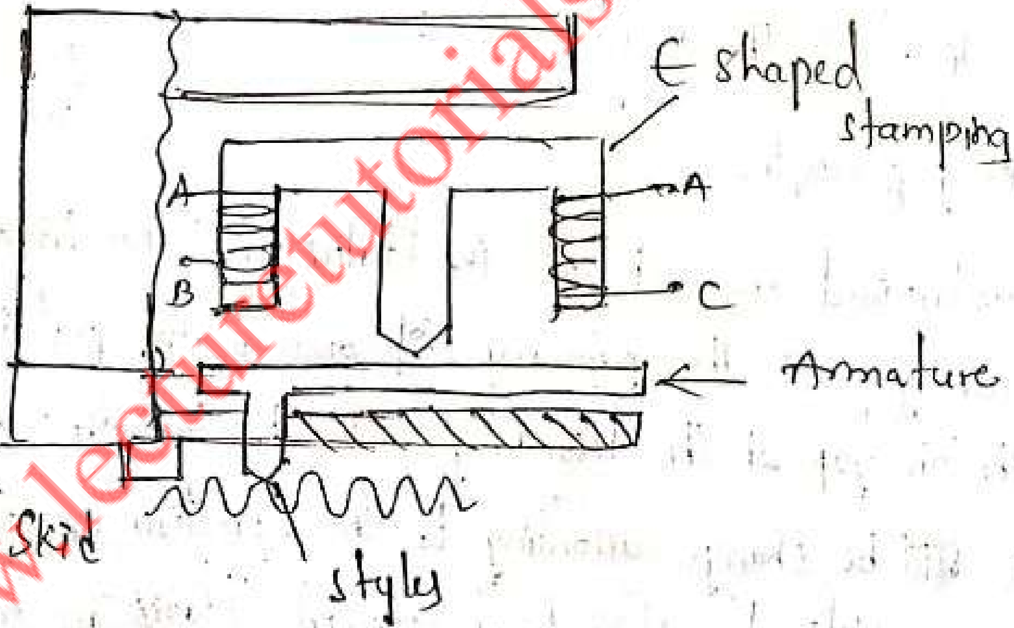
② In the measurement of surface roughness heights of 10 successive peaks and throughs was measured from a datum and are 33, 25, 30, 19, 22, 18, 27, 29 & 20 microns if these measurements were obtained on a 10 mm length determine CLA & RMS values of surface roughness

Sol → CLA method $= \dfrac{h_1+h_2+h_3+h_4+h_5+h_6+h_7+h_8+h_9+h_{10}}{10}$

RMS method $= \sqrt{\dfrac{y_1^2+y_2^2+y_3^2+y_4^2+y_5^2+y_6^2+y_7^2+y_8^2+y_9^2+y_{10}^2}{10}}$

Taylor - Hobson - Talysurf





$h_q + h_m$

$= 20.4$

$y_q + y_m$

$= 22.38$

→ The [illegible] of the [illegible] surface roughness are as

a) E-shape stamping
b) Armature
c) stylus
d) cylindrical skid.

<u>construction:-</u>

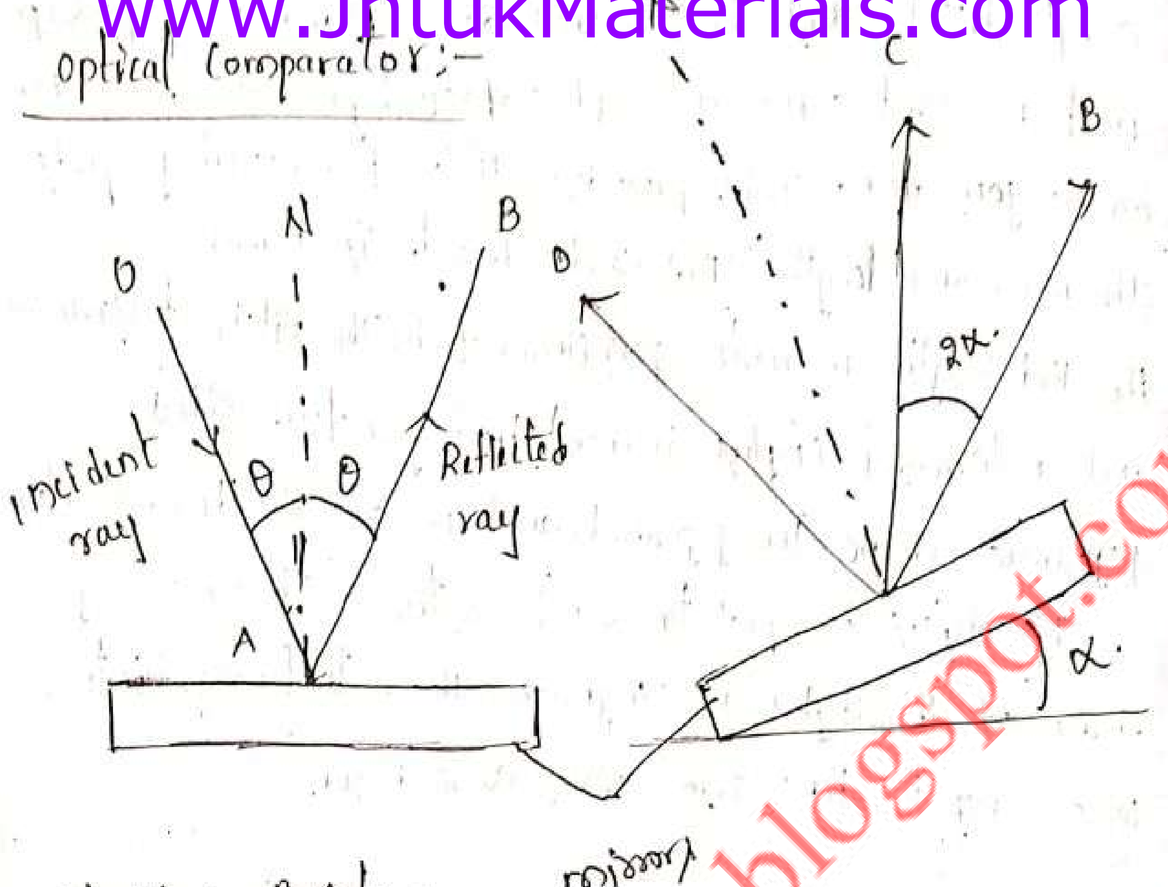
The stylus is mounted on the armature which is provided at the central ~~link~~ limb of an E-shape soft iron head the outer limbs of the head are provided with two induction coils and the small air gap is left b/w the armature and outer limbs of the head

<u>Working principle:-</u>

A downward moment of the stylus results in decreasing the air gap of the primary coil and in an equal increase of the air gap at the secondary coil the impedence of the coils will be change according to the variation of air gap and an additional alternating current flows in the secondary coils whose magnitude is governed by the variation of the impedence of the coil and is propotional to the displacement of the stylus the position of the stylus. controls/modulates the carrier This method of carrier modulation enables Two graphs of the surface Texture to be obtained.

A cylindrical skid is provided as a datum and a pickup unit is moved across the Test surface by means of a motor and a gear box. This provides different measuring speeds. The maximum length That can be traced. is 10 mm. The skid length is made greater than twice the pitch of waviness and a diamond stylus is used having a four sided pyramid shape the pyramid angle is 90° and the nose radius of the stylus is equal to 2 micrometers the measuring force of the stylus is 0.1 grams the vertical magnification can be vary in steps from 1000 - 15000 times.

optical Comparator:-



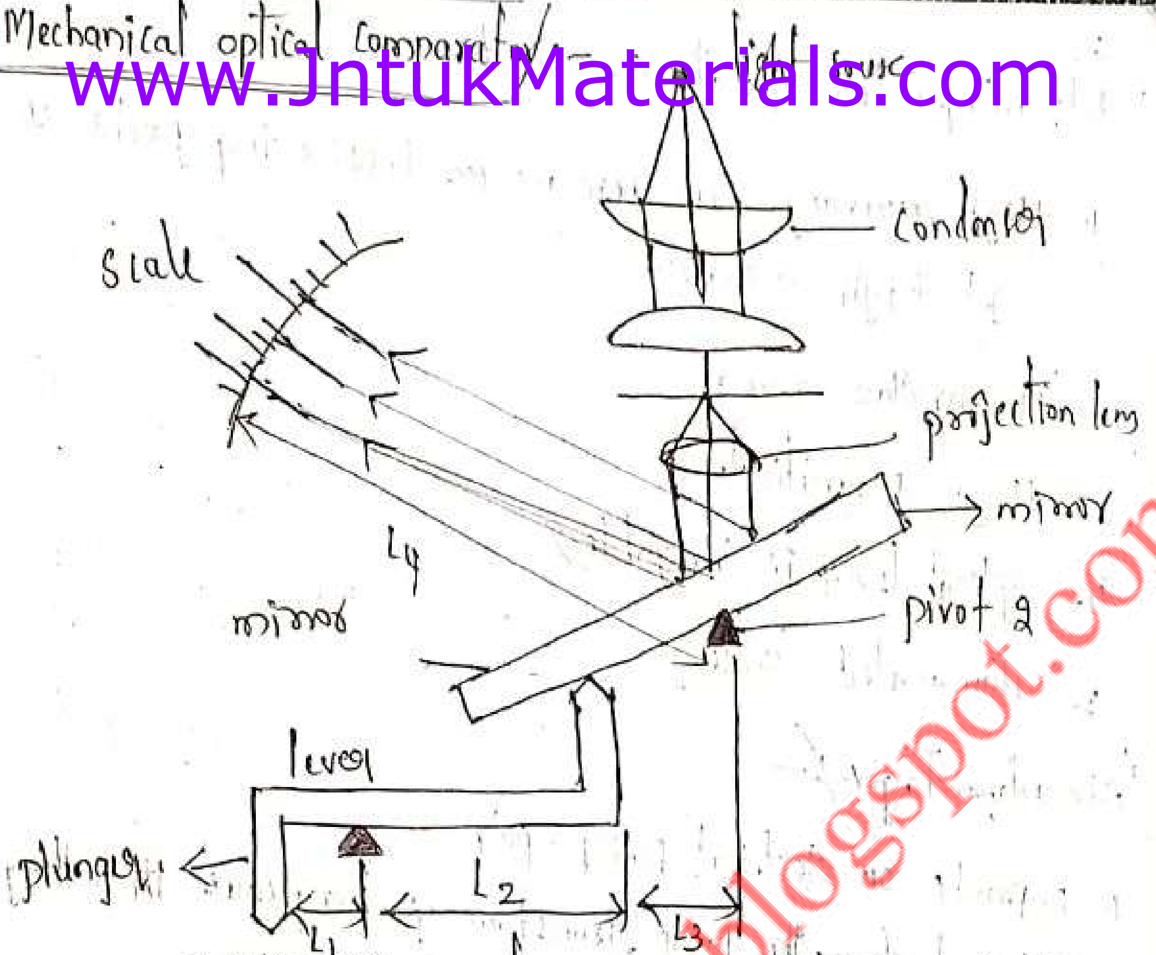
Working principle:-

~~When~~ In these comparators, the fundamental principle of an optical law and instead of a pointer the edge of the shadow is projected on to a curved graduated scale to indicate the comparision measurement if a ray of light OA strikes the mirror gets reflected has a ray AB such that

~~Angle~~ $\angle OAN = \angle NAB = \theta$

Now if the mirror is tilted to an angle 'α' the reflected ray of light is tilted to angle '2α' and optical comparators the mirror is tilted by the measuring plunger moment at the moment is reflected like is recorded as an image on a screen.

Mechanical optical comparator:-



In this comparator the small displacement of the measuring plunger are amplified first by a mechanical system consisting of pivoted mechanical levers the amplified mechanical moment is further amplified by a single optical system involving the projection of an image from the fig. We can see that as the plunger is deflected in the vertical directions the lever tills about the pivoted point. and as the other end of the lever is attached to the mirror the mirror is tilted about the pivot-2 and the image of the index is projected on a scale on the inner surface of a ground glass screen and the magnification of the system is given by $= 2 \times \frac{L_2}{L_1} \times \frac{L_4}{L_3}$

Advantages of optical comparators:-

1. High accuracy :- as there are few moving parts we get high accuracy
2. No parallax error.
3. High Magnification.
4. optical lever is weightless
5. illuminated scale

Disadvantages:-

1. Depends on electrical power supply
2. The heat from the lamp, Transformers may cause the setting the drift when high Magnification used.
3. The system is bulky, it is Expensive
4. the instrument is to be use in a dark room
5. Instrument is inconvient for continous use because the scale to be use ~~or~~ to be is through eye piece