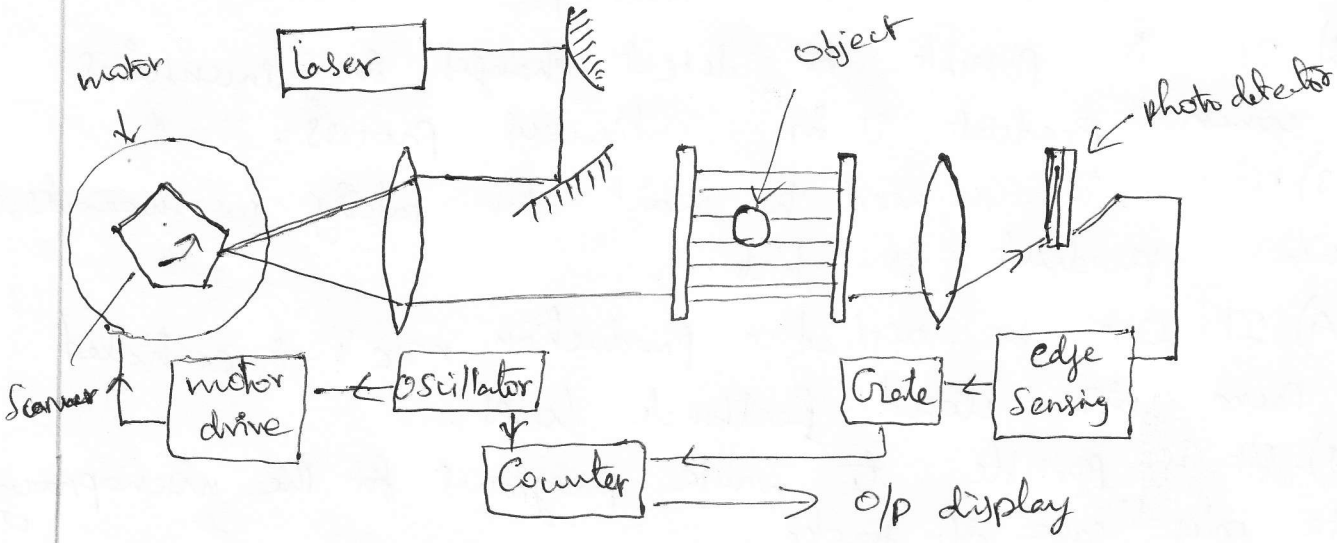
UNIT-3.

ADVANCES IN METROLOGY.

(1) Briefly explain about laser Telemetric system.

It is a non contact gage that measures with a collimated laser beam. It measures the rate of 150 scans/s.

Construction (diagram)



The receiver collect the laser beam photo electrically senses the laser light transmitted through the object being measured. The Processor receives the signal & convert it into convenient form.

The transmitter has the following components

1) low power He-Ne laser.
2) synchronous motor
3) collimating lens.
4) Reflector Prism
5) synchronous pulse photo detector
6) Replacable window.

Working

Measurement medium object is measured by constant linear speed laser beams forms transmitter which is focused on the object to be measured.

After sensing the processer electronics take the received signals and convert them into a convenient form and then display the dimensions being gauged.

Advantages:-

1) It is possible to detect changes in dimensions when components are moving.
2) It is possible to detect changes in dimensions when product is in continuous process.
3) There is no need to wait for taking measurements. when product is hot.
4) It can be applied on production m/c's & controlled them with closed feedback loops.
5) It is possible to write programs for the microprocessor to take care of smoke.

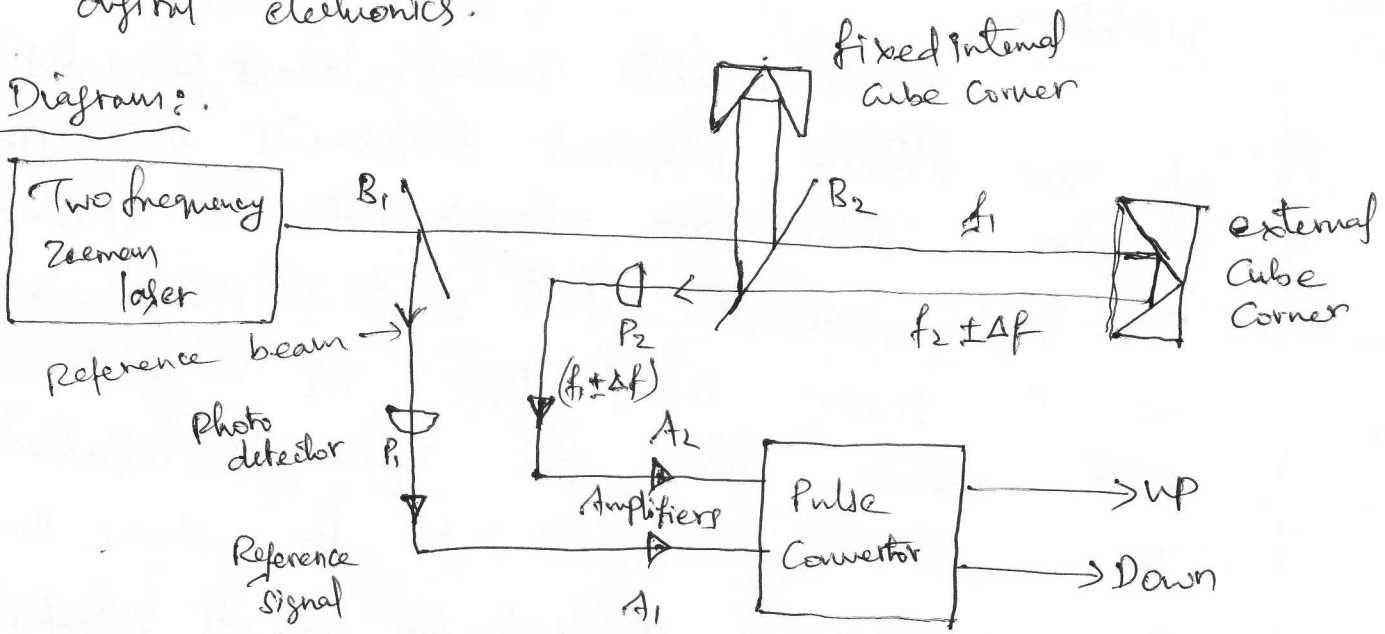
Laser metrology.

Laser is used in sensing applications in this world depends upon its wave length. It is used in measurement sectors to measure a machined component without contact the surface of it. especially if it is used in micro, nano level pointer measurement a monochromatic light beam, krypton laser, are mostly used for measuring applications and it produced high frequency beam laser.

(2.) Explain in Detail about AC laser interferometer with neat sketch.

AC laser light used to measure over longer distance. laser represents a source of intensively monochromatic optical energy, which can be collimated into a directional beam. the laser beam wave length is exact and pure for highly accurate measurements. It is utilize the principles of optical & digital electronics.

Diagram:



Two frequency Zeeman laser.

1) It is Generally He-Ne type
2) Generate stable Coherent light beams of two frequencies.
3) Polarized vertical & polarized horizontal.

Beam Splitter B_1 & B_2

1) Devide beams into 2 seperate beams.
2) different axis.

Cube Corners.

1) Plane mirror roof prisms.
2) one is fixed internal & other one is movable external
3) each are perpendicular.

Photo detector.

receives light beams & convert it as a electrical signal.

Amplifier:.

used to seperate the frequency differences.

Pulse Converter.

it extract the frequency changes in Δf.

Working:

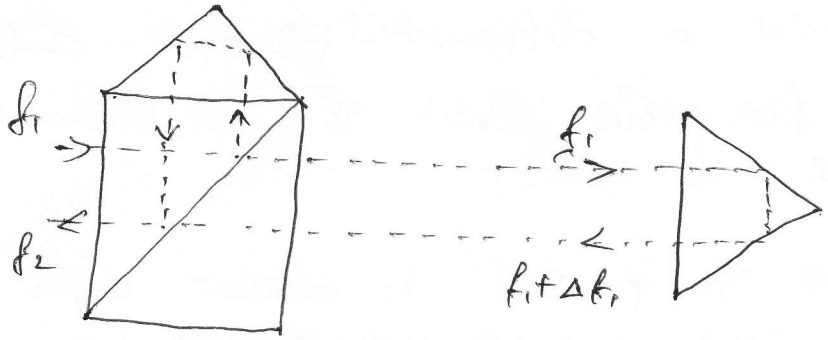
Two frequencies Zeeman lasers generates light of two slightly different frequencies with opposite Circular polarization. the beams are splitted by B_1 & B_2. one is deflect $\perp$ to B_1 & another one is passing through B_1 & B_2 to extend Cube corner where the beam is reflected by a mirror and it is to B_2 where the two beams are splitted by B_2 & interference into the B_2 with different wave length. the photo detector P_1 receives signal from beam splitter B_1 & changes the reference Beam f_1 & f_2 into electrical signal.

the two amplifiers A_1 & A_2 seperate frequency different signals $f_2 - f_1$ & $f_2 - (f_1 + \Delta f)$ the pulse Converter extracts Δf and displays in the form of pulses in analog or digital form in the output.

3. Applications of laser interferometer.

1) Linear measurement

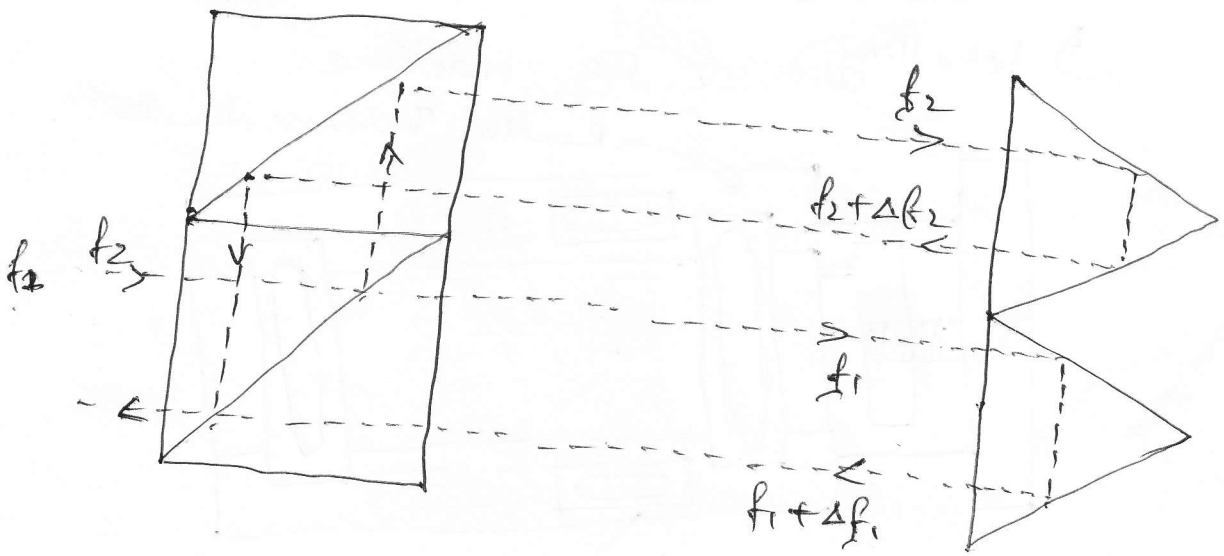
In linear measurement, the beam existing from the laser head is splitted up at the surface of a polarizing beam splitters.



In splitted two frequencies one is reflected into the reference cube corner & other beam is transmitted to the measuring retro reflector.

Both frequencies are reflected into back along a common axis to the photo detector block. In the two frequencies one include a Doppler frequency shift whenever the measured retro reflector moves.

2) Angle measurement



In angular measurements a 45° mirror is mounted in place of the reference retro reflector so that the two frequencies $f_1 \times f_2$ sent out parallel.

The angular displacement of retro reflector mount causes a differential Doppler shift in the returned frequencies which is not done by axial displacement.

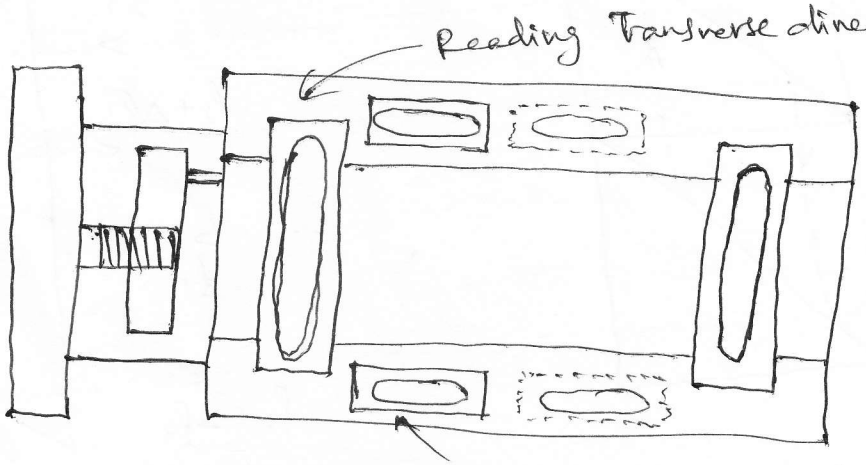
It is positive to measure angle upto $10 \pm 10°$ with a resolution of 0.1 second with laser interferometer. The change in length in the path difference of the reflected beam represents the side of the triangle opposite to the angle being measured.

(4) Laser equipment for Alignment Testing.

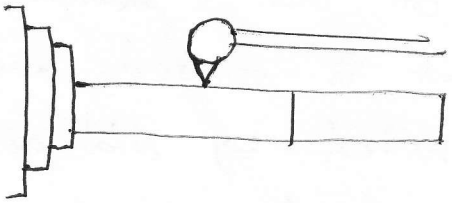
It is particularly for aircraft production, shipbuilding etc.

Alignment testing on lathe.

1) levelling of the machine.

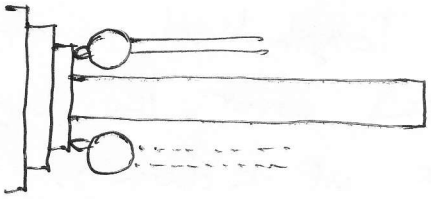


2) True running of locating Cylinder of main spindle.



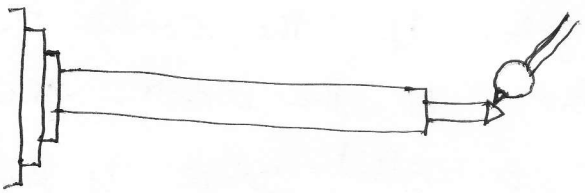
locating Cylinder is provided to locate the chuck or face plate.

3) Axial slip of main spindle and true running of shoulder face of spindle nose.



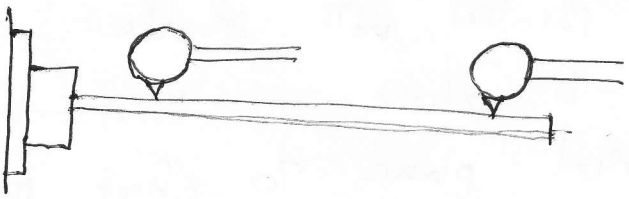
It is defined as the axial spindle movement which follows the same pattern and is due to ~~mfg~~ error.

4) True running of headstock centre.



It is measured by using the dial indicator. It is pressed perpendicular to the taper surface of centre.

5) True running of taper socket in main spindle.



This test is done by using mandrel by fitting into the tapered hole.

ALLIGNMENT TEST ON MILLING M/C.

1) cutter spindle axial slip or flat.

* feeler of dial gauge tests on the face of locating spindle shoulder & dial gauge holder is clamped to the table.

2) eccentricity of external diameter.

feeler is placed on the cylindrical surface of the shoulder. shoulder is rotated and any deviations in reading is noted by dial gauge.

3) Surface parallel with longitudinal movement.

In this test dial gauge is fixed to spindle. deviation from parallelism between the table surface and longitudinal motion are noted down. Due to this error, the surface of table will fluctuate up & down.

4) Centre T-slot square with arbor.

cut on the m/c will not be parallel to the axis of job. if the centre T-slot is not perpendicular to the arbor. the keyways check this error, a dial gauge is fixed on the mandrel, the feeler being adjusted to touch the vertical face of bracket.

5) Over arm parallel with spindle.

It is done on horizontal plane as well as vertical plane. To check the parallelism of the over arm and the spindle, the dial gauge is fixed on table and its feeler under the mandrel. The table is moved crosswise and change in reading is noted.

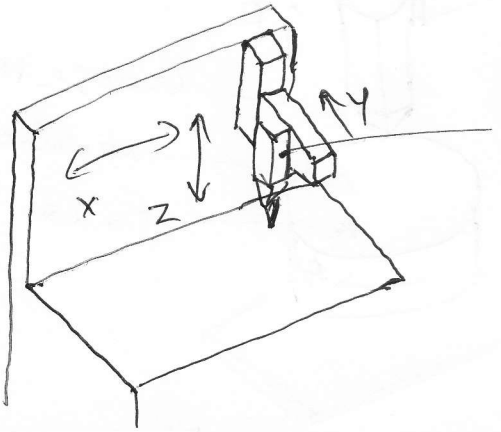
5. Briefly explain about the types of CMM:-

The coordinate measuring m/c is used to contact inspection parts. when it is used for computer-integrated manufacturing, the CMM is controlled by ~~xxx~~ Computer numerical control.

Types:

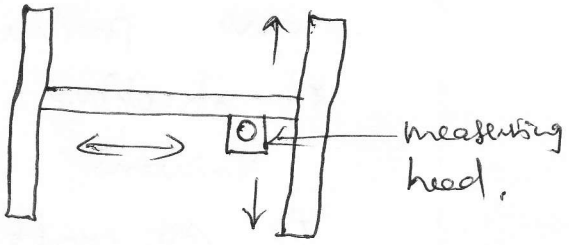
1) Cantilever type.

It is easy to load and unload, but it is most sensitive, to mechanical error because of sag or deflection in y axis beam.



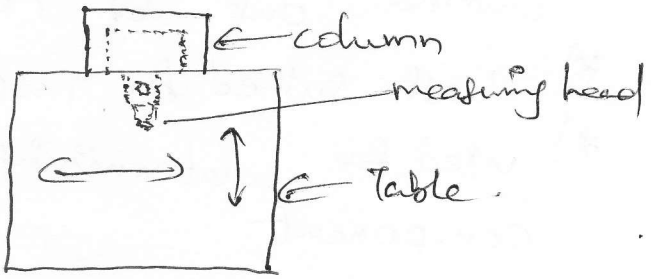
2) Bridge type.

It is difficult to load but less sensitive to mechanical errors. A floating bridge type m/c is also available in which the complete bridge can slide in y-direction.



3) Horizontal boring mill type.

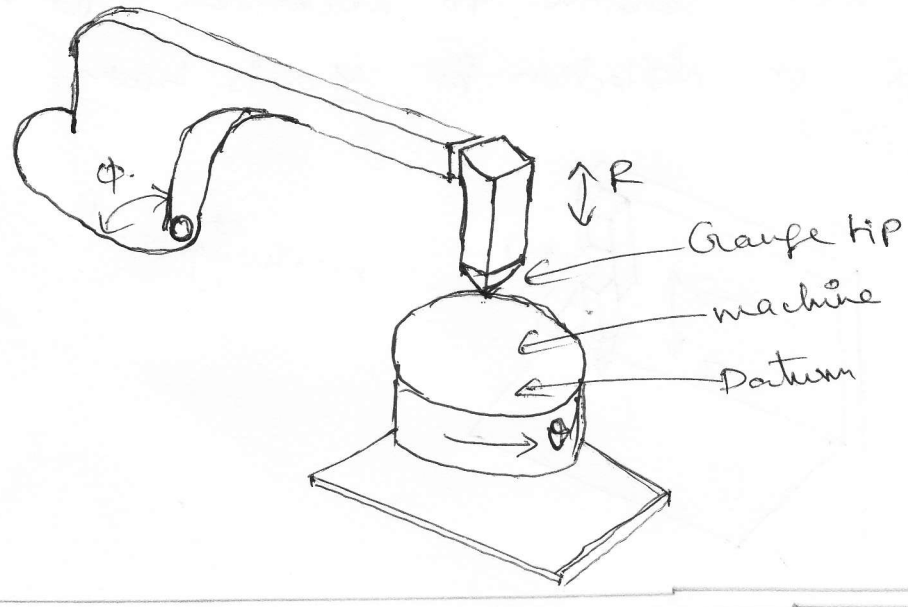
It is best for large heavy work pieces.



vertical boring mill type.

working. It is highly accurate but slower to operate.

when the distance is measured b/w two holes using CMM, the w/p should be clamped to the worktable and alignment for three measuring slides X, Y, Z. Now the tapered probe tip is seated in first the hole and probe position digital readout is set to zero.



(6) List down the applications of CMM.

*) Automatic, m/c tool electonics, space & large companies.
*) It is ideally suited for development of new products & construction of prototype
*) checking NC produced work piece in various steps of production
*) Air craft & space vehicle inspection is carried out by CMM.
*) best suited for inspect gauges & tools
*) used for determining dimensional accuracy of component

(7) What are the features of CMM.

*) faster m/c's with higher accuracy. The stiffness to weight ratio has to be high in order to reduce dynamic forces.

*) All the moving members, the bridge structure Z-axis carriage & Z-column are made of hollow box construction.

*) Errors in machine are built up and fed into the computer system so that error compensation is built up into the software.

*) All machines are provided with their own computer's and CMM can able to measure three dimensional object from variable datumms.

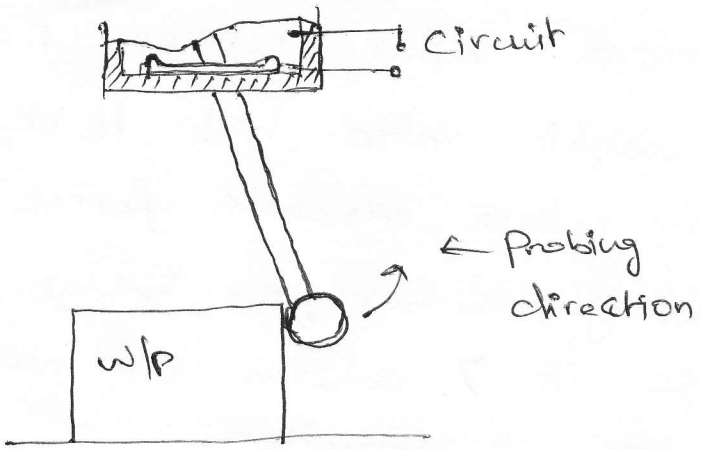
*) For compensation of temperature gradient, Thermocouples are connected with the m/c and interfaced with the computer. This will provide the CMM in high accuracy and repeatability.

*) Rapid growth in software for three & four axes movements enable CMM to measure holes center distances and form measurements such as turbine values.

(8) Probe: what is mean by Probe & Give its type.

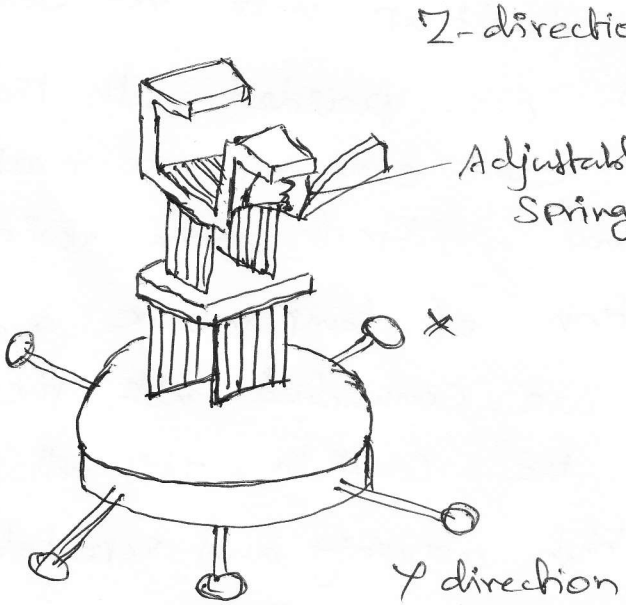
Probe is a measuring tip which can be different in shape. It is directly contact with workpiece for measurement.

Types:- Trigger type.

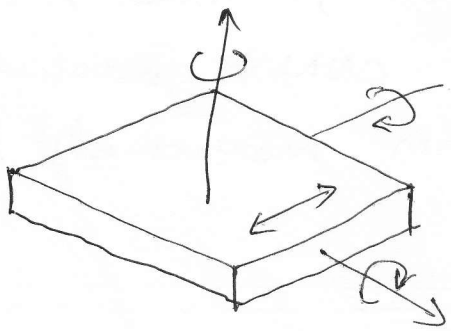


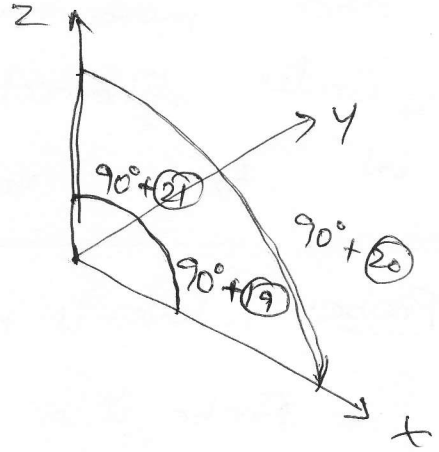
The "buckling mechanism" is a three point bearing the contacts of which are arranged at 120° around the circumference. Probing force is determined by Prestressed force of spring.

Measuring type probe system



It is a small Co-ordinate measuring m/c itself. The measurement can made easily because the entire system is free from torsion play & friction.





(9) Explain about the CMM Software & its features.

In CMM the computer & Software represents one system, the efficiency & cost effectiveness depend on the Software.

Features of CMM Software.

1) Measurement of diameter, centre distance, length
2) Measurement of plane and spatial curves.
3) Minimum CNC programme.
4) Data Communications.
5) Digital Input and output Command.
6) interface to CAD Software.

(10) List down the Accessories used in CNC System.

1) Stationary Granite Table :-

It Provide stable reference plane for locating parts to be measured.

2) Length measuring systems.

Three axes CMM are provided digital incremental length measuring System for each axis.

3) Air bearing

The bridge cross beam & Spindle of CMM are supported on air bearings.

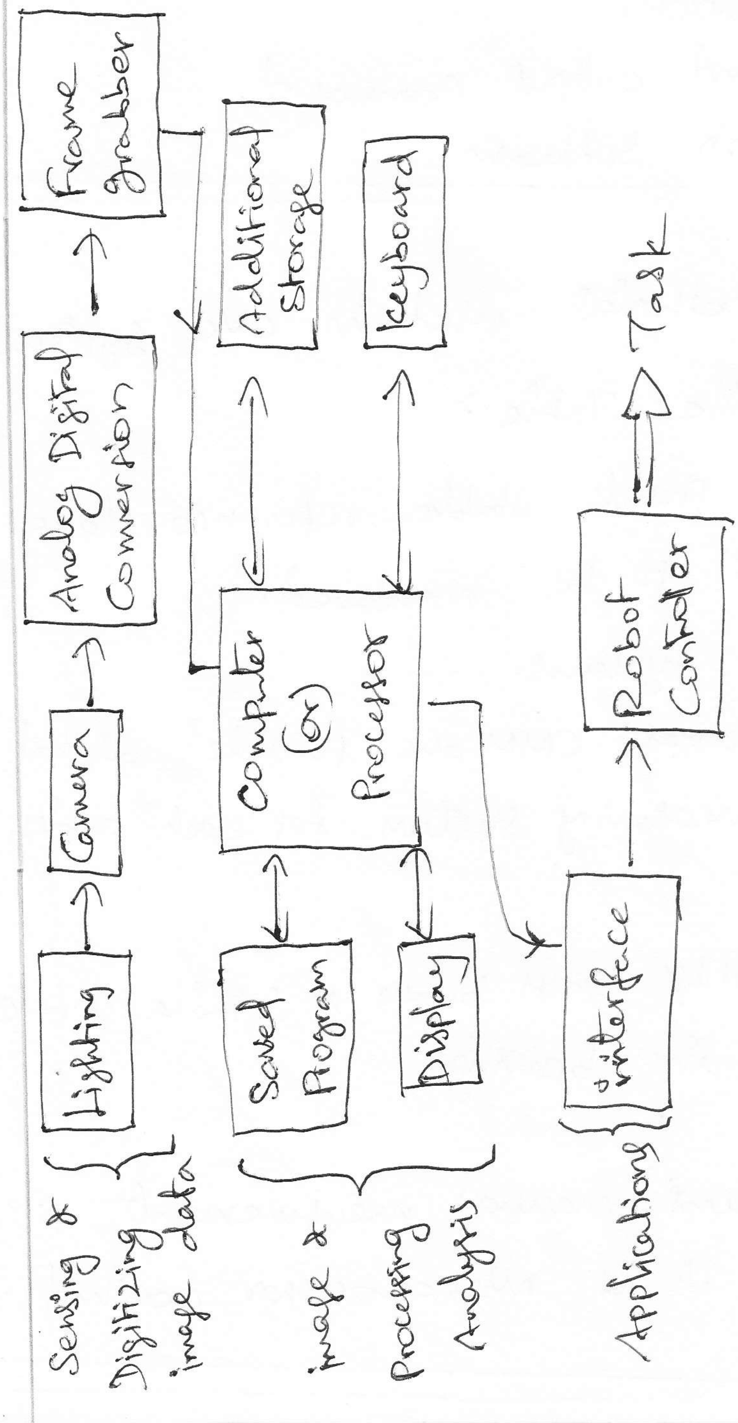
4) Control unit.

It allows manual measurement and programme. It is microprocessor control.

5) Software

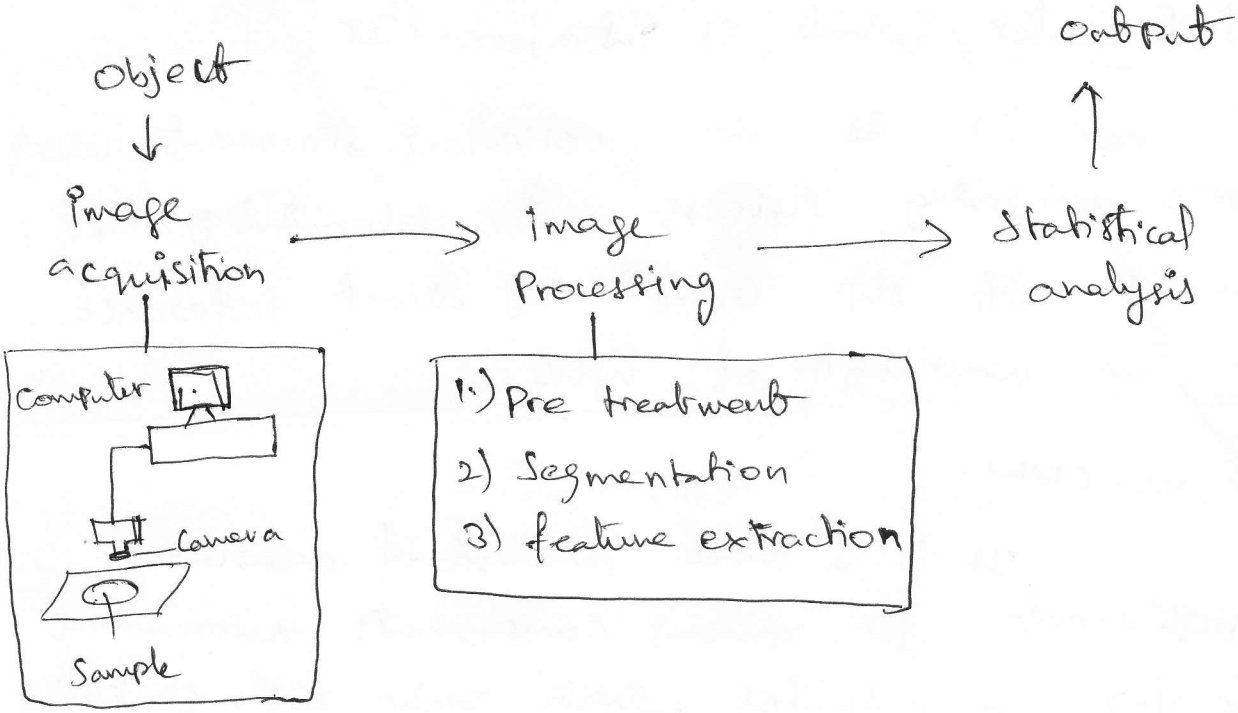
11) MACHINE VISION SYSTEM. (7)

Briefly explain about machine vision system with suitable block diagram.



Block Diagram of MVS.

Process diagram of MVS.



It is controlled by three different system.

1) Sensing image. → to capture a clear visible object via camera.
2) Processing image → Re Processing or to give a cleared image and convert it into program it is also a saving device to store a data's.
3) Application → some social or industrial purpose.

Pretreatment :→ noise removal, contrast enhancing

Segmentation :→ Threshold / Region / Gradient / classification

feature extraction :- *) Size, length, width, area, perimeter
*) shape, size dependent / independent
*) colour : mean & variance.
*) A combination of them.

2 marks.

(1) Interferometer what is interferometer?

It is an optical instrument used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.

(2) Define - CMM.

It is a three dimensional measuring instrument for various components. movement x-y-z co-ordinates which can be easily controlled & measured. each slide in three directions is equiped with a precision linear measurement transducer which gives digital display and senses positive & negative direction.

(3) Define straightness:-

straightness of axes is defined as deviation from a straightline in two orthogonal planes for each axis movement and six measurements to be considered. straight axis x is measured in Y & Z directions.

(4) Define Machine vision:-

Machine vision can be defined as a means of simulating the image recognition & analysis capabilities of human system with electronic and electromechanical techniques.

(5) List down the advantages of CMM.

*) inspection rate is increased.
*) Accuracy is reduced.
*) No need of GO/NOGO Gauges.
*) Reduction of Scrap & good Part rejection

(6) Explain applications of MVS..

1) used for printed Circuit board
2) this is for the recognition of object from its image.
3) Achieve 100% accuracy.
4) used to replace, machine for applications like welding, machining to maintain relationship b/w tool & work.

(7) what are the steps involved in Producing Software for engineering metrology?

1) precise & detailed definition of Geometrical form.
2) Specification of the measurement Procedure.
3) Mathematical model of measurement

(8) what is the advantages of using laser beam interferometry?

Laser Provides a source of coherence and truly monochromatic light. The Property of clearance enables it to be projected in a narrow Pencil of beam without any Scatter.

(9) State the applications of CMM in Reverse engineering.

It is used for determining of shape and position, maximum metal condition. It is also best suited for ensuring economic usability of NC machines by reducing their down time for inspection results.

(10) Why laser is prefered in Engineering mehology?

It is used in Enginering mehology because of its properties such as high precision high accuracy, rapid ~~not~~ non-contact gauging of soft, delicate or hot moving points.

(11.) List the components of laser interferometry?

*) Two frequency Leser source.
*) optical elements.
*) Laser heads measurement receiver
*) mesurements display.

(12.) Define interferometry.

It is a nature of light. The light is considered as wave motions propagated in ether. The high point of the wave is called crest & low point is called trough. The distance b/w two troughs or two crests is called wavelength λ.