E.G.S. PILLAY ENGINEERING COLLEGE
(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai Accredited by NAAC with "A" Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

DEPARTMENT OF MECHANICAL ENGINEERING

IV SEMESTER

1702ME402 - MEASUREMENTS AND METROLOGY LABORATORY

LAB MANUAL

Prepared & Compiled by

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Laboratory in Charge

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1702ME402 - MEASUREMENTS AND METROLOGY LABORATORY

Name : .....

Reg. No. : .....

Branch : .....

Year & Sec. : .....

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15					

Completed Date:

Average Mark: **Staff-in-charge**

LIST OF EXPERIMENTS

EX. NO.: 1	INTRODUCTION TO METROLOGY AND MEASUREMENTS	DATE:

AIM:

To study about the basics of the metrology and measurements.

FUNDAMENTALS:

Metrology is a "Science of measurement'. The most important parameter in metrology is the length. Metrology is divided into Industrial Metrology and Medical Metrology under consideration of its application and may be divided into metrology of length and Metrology of time under consideration of its quantity.

FUNCTIONS OF METROLOGY:

- To ensure conservation of national standards.
- Guarantee their accuracy by comparison with international standards.
- To organize training in this field.
- Take part in the work of other National Organization.
- To impart proper accuracy to the secondary standards.
- Carry out Scientific and Technical work in the field of measurement.
- Regulate, supervise and control the manufacturer.
- Giving advice to repair of measuring instruments.
- To inspect and to detect guilty of measurement.

APPLICATIONS OF METROLOGY:

- Industrial Measurement
- Commercial transactions
- Public health and human safety ensuring.

BASIC CONCEPTS OF MEASUREMENTS:

- Measurement is the outcome of an opinion formed by observers about some physical quantity.
- Measurement is an essential part of the development of technology.
- Measurement is a complex of operations carried out by means of measuring instruments.

ELEMENTS OF A MEASUREMENT:

***Measurand*:** It is a physical quantity or property (length, diameter, thickness, angle etc.).

***Reference*:** Reference is a physical quantity or property and comparisons are made by them.

***Comparator*:** Comparing measurand with some other reference.

NEED FOR MEASUREMENT:

- To determine the true dimensions of a part.
- To increase our knowledge and understanding of the world.
- Needed for ensuring public health and human safety.
- To convert physical parameters into meaningful numbers.
- To test if the elements that constitute the system function as per the design.
- For evaluating the performance of a system.
- To ensure interchangeability with a view to promoting mass production.
- Check the limitations of description in actual situation.
- To establish the validity of design and for finding new data and new designs.

RESULT:

Thus the basics of the metrology and measurements are studied.

EX. NO.: 2	COMPARING THE ACCURACY OF VERNIER CALIPER, VERNIER HEIGHT GAUGE, VERNIER DEPTH GAUGE AND MICROMETER TO CHECK THE VARIOUS DIMENSIONS OF A GIVEN SPECIMEN	DATE:

AIM:

To compare the accuracy of Vernier Caliper, Vernier Height Gauge, Vernier Depth Gauge and Micrometer to check the various dimensions of a given specimen.

APPARATUS REQUIRED:

- Vernier Caliper
- Vernier Height Gauge
- Vernier Depth Gauge
- Micrometer
- Specimen

1. DESCRIPTION OF VERNIER CALIPER:

Vernier caliper has two scales namely the main scale and Vernier scale which moves along the main scale. Verniers are used to measure both internal and also external dimensions. The caliper is placed on the object to be measured and the fine adjustment screw is rotated until the jaws fit tightly against the workpiece. The readings from the main scale and Vernier scale are taken. The main principle of Vernier is that the two scales of different sizes are used to measure the dimension in high accuracy. The least count of Vernier caliper is 0.02mm.

2. DESCRIPTION OF VERNIER HEIGHT GAUGE:

This is also a Vernier caliper but attached with a special block and other attachments. The whole assembly is made in such s way to measure height of parts to be measured. A removal clamp is attached between measuring jaw and Vernier. Both upper and lower end of measuring jaws are parallel to the base of Vernier height gauge. A scribbling attachment is fitted to mark scribe lines on the parts where it is required. Sometimes the measuring jaws of the Vernier are replaced by a dial gauge according to the type of measurement is needed. Least count of Vernier height gauge is 0.02mm.

3. DESCRIPTION OF VERNIER DEPTH GAUGE:

A Vernier depth gauge is one type of Vernier caliper. The graduated scale is directly slide through the base but the Vernier scale remains stationary. This instrument is mainly used for measuring the depth of holes, recesses and distance from a plane. The range trueness and squareness of Vernier depth gauges should be correct. Otherwise the rest of the depth gauges will be inclined. The base and anvil should be firmly rested on the surface of the part to be measured. If it is not so the base may be lifted above the surface of the part. Sometimes the base may be affected by a trifle affected when the applied force increases. The least count of Vernier depth gauge is 0.02mm.

4. DESCRIPTION OF MICROMETER:

The micrometer is a linear measuring instrument. The micrometer has an accurate screw consisting of 10 to 20 threads per cm. This screw rotates inside a fixed nut. The end of the screw acts as one measuring tip and fixed anvil acts as other measuring tip. Threads are cut for certain length on screw and it is left to free remaining portion called sleeve. The spindle moves towards the fixed anvil or away from it by rotating the thimble. The spindle is placed inside the barrel in such a way to freely to slide over the barrel. The barrel is firmly fixed with the frame. 20 divisions per cm are made in the barrel. This is the lead screw for one complete revolution. One complete rotation of barrel is produced 0.5 mm movement of an anvil and the least count of micrometer is 0.01mm

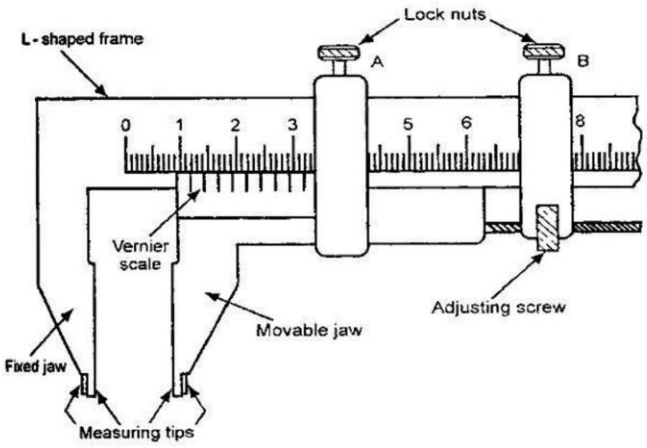
PROCEDURE FOR VERNIER CALIPER, HEIGHT GAUGE AND DEPTH GAUGE:

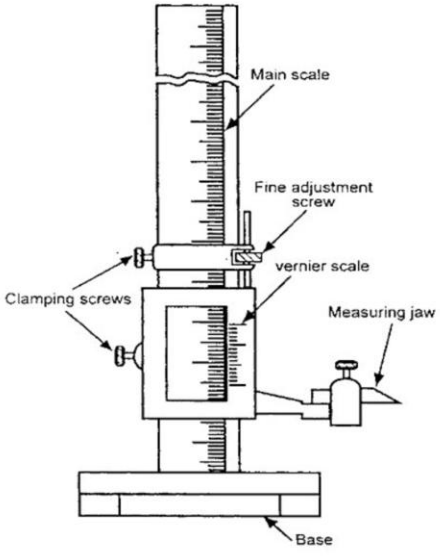
1. Check the zero reading for error.
2. Place the workpiece to be measured in between the measuring face.
3. Adjust the sliding jaw until there is no further movement of sliding bar.
4. Note the main scale, Vernier reading for the calculation of workpiece dimension.
5. Tabulate the readings.
6. Then the dimension of workpiece is calculated and average value is taken.

PROCEDURE FOR MICROMETER:

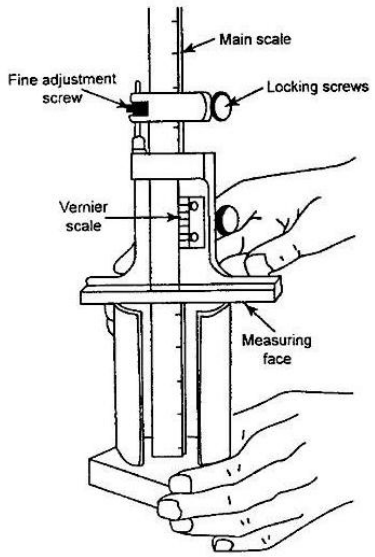
1. Check the zero position for error.
2. Place the specimen to be measured.
3. Adjust the spindle by rotating the ratchet unit at began to slip.
4. Note the reading on the main scale and the thimble scale.
5. By calculating the division on both scales the reading was tabulated.
6. Thus the thickness of the workpiece was measured.

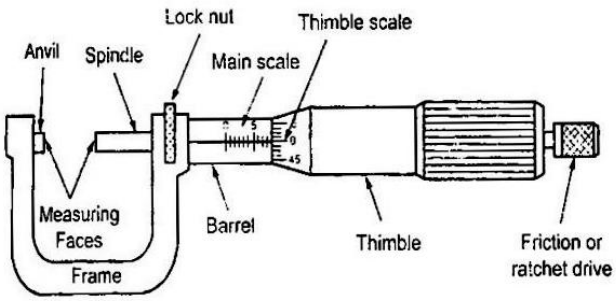
DIAGRAM:





(i) Vernier Caliper **(ii) Vernier Height Gauge**





(iii) Vernier Depth Gauge **(iv) Micrometer**

TABULATION:

Trial No.	Type of the instrument	Main Scale Reading (MSR) *(mm)*	Vernier / Thimble Scale Reading (VSR/TSR) *(mm)*	Measured Value of the Specimen =MSR+ VSR *(mm)*	Average Value *(mm)*
1	**Vernier Caliper**				
2	**Vernier Height Gauge**				
3	**Vernier Depth Gauge**				
4	**Micrometer**				

RESULT:

i. Length of the Specimen : ----------

ii. Height of the Specimen : ----------

iii. Depth of the Specimen : ----------

iv. Thickness of the Specimen : ----------

Thus the accuracy of Vernier Caliper, Vernier Height Gauge, Vernier Depth Gauge and Micrometer is compared for a given specimen.

OUTCOME:

Students will be able to select proper linear measuring instruments and know requirement of calibration, errors in measurement can perform accurate measurements.

APPLICATIONS:

1. Quality Department

EX. NO.: 3	CHECKING THE DIMENSIONAL LIMITS OF COMPONENTS USING MECHANICAL COMPARATOR	DATE:

AIM:

To check the dimensional limits of the given workpiece with a standard specimen using mechanical comparator.

APPARATUS REQUIRED:

- Mechanical Comparator
- Standard specimen

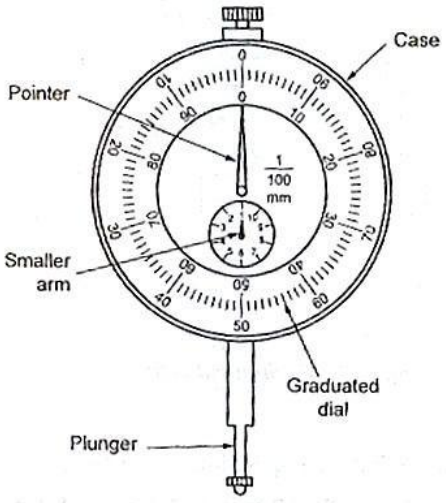
DESCRIPTION:

The mechanical comparator is a one of the type of comparator used to only check the specimen. There are graduations in the dial gauge and there is a counter dial in the gauge. There is a plunger, by this sensitive plunger the pointer in the dial gauge points out the reading. By using the slip gauge the values of the specimen was verified. The least count of mechanical comparator is 0.01mm.

PROCEDURE:

1. Measure the height of the specimen using a vernier height gauge.
2. Take a standard specimen and get the value in the comparator.
3. Check for the deviation from standard value using the dial gauge.
4. Check all the test pieces, note down the variations, and mention if it is 'Accepted' (or) 'Rejected'.

DIAGRAM:



TABULATION:

Height of the Standard Specimen :

Tolerance :

Trail No.	Dial gauge reading		Actual Reading *(mm)*	Deviation *(mm)*	Sample Accept/ Reject
	Divisions	*(mm)*			
1					
2					
3					
4					
5					

RESULT:

The dimensional limits of the given workpiece are checked with a standard specimen using mechanical comparator.

OUTCOME:

Students will be able to check the variation in tolerance during the inspection process of a machined part.

APPLICATIONS:

1. Alignments checking in Lathe, Drilling and Milling machines.

EX. NO.: 4	MEASUREMENT OF TAPER ANGLE OF A SPECIMEN USING SINEBAR	DATE:

AIM:

To measure the taper angle of given specimen using Sinebar.

APPARATUS REQUIRED:

- Sine bar
- Slip gauge
- Surface plate

DESCRIPTION:

Sine bars are always used along with slip gauge as the device for the angle measurement. Generally sine bars are made from high carbon, high chromium and corrosion resistant steel. These materials are highly hardened, ground and establish. In sine bars two cylinders of equal diameter are attached at the ends parallel to each other. The distance between two cylinders is 100mm, 200mm, or 300mm. There are some relief holes was made in the sine bar mainly to reduce the weight also to facilitate handling.

FORMULA:

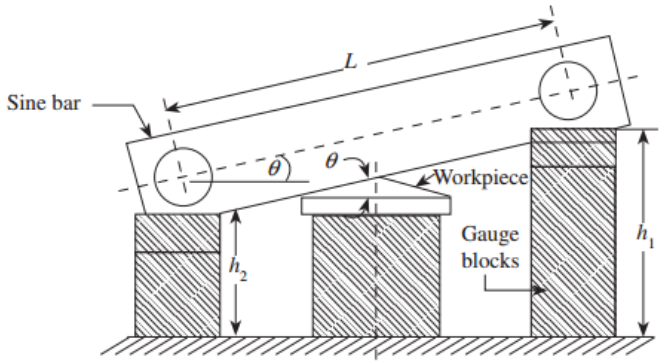
$$\mathbf{Sin\ \theta = h_1\text{-}h_2/L}$$

Here, h is the required slip gauge combination in mm and L is the spacing between the rollers in mm.

PROCEDURE:

1. Clean the surface plate and Place the set-up on the surface plate
2. Note down the length of the sine bar
3. Note down the dimensions of the slip gauges available
4. For the given angle, calculate the height of the slip gauge required
5. Bring all the selected slip gauges together, so that the combination gives the height h
6. Place the sine bar with the contact roller on top of the combination of slip gauges on the surface plate, as shown in Fig.
7. Measure the built-up angle to ascertain accuracy, if angle/gap gauges are available

DIAGRAM:



TABULATION:

Trail No.	Height of Slip Gauge at left side (h_1) *(mm)*	Height of Slip Gauge at right side (h_2) *(mm)*	Angle (θ) $(h_1-h_2)/l$ *(degree)*
1			
2			
3			
4			
5			

RESULT:

The taper angle of the given specimen using sinebar is ----------degrees.

OUTCOME:

Student will become familiar with sinebar that is available for angular measurements.

APPLICATIONS:

1. To measure unknown angle of the specimen
2. To locate the tool for known angle

EX. NO.: 5	MEASUREMENT OF THREAD SPECIFICATIONS BY FLOATING CARRIAGE MICROMETER	DATE:

AIM :

To measure the major, minor and effective diameters of given thread component by using Floating Carriage Micrometer.

APPARATUS REQUIRED:

- Floating Carriage Micrometer
- Standard wires
- Specimen screw
- Specimen

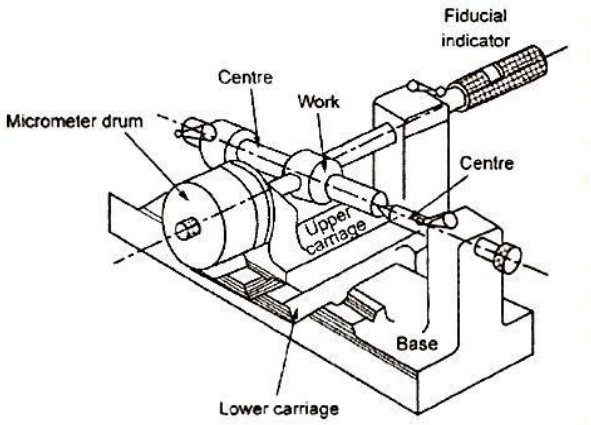
DESCRIPTION:

Floating carriage micrometer is also a micrometer used to measure the major diameter, minor diameter and the effective diameter of a threaded surface. This micrometer having a main scale, thimble scale and an anvil and also a pressure gauge is attached to measure the applying pressure. The least count of the floating carriage micrometer is 0.002mm.

PROCEDURE:

1. First the indicator of the pressure gauge is set to zero by using initial adjustment then the specimen is placed between two centre's, the standard dimensions in the corresponding values are noted.
2. Then the thread plug gauge is placed in the two centers for measuring the effective, major and minor diameter.
3. Simultaneously the thread work piece is first measured by placing between the two centers.
4. By placing the prism plug gauge, the readings are noted. By using the formula, we can calculate the R_w of the work piece.

DIAGRAM:



FORMULA:

1. Major diameter

Max = D + (Rs – Rw) Min = D - (Rs – Rw)

2. Minor diameter

Max = D + (Rs – Rw) Max = D - (Rs – Rw)

3. Effective diameter

Max = D + (Rs – P) - Rw Max = D + (Rs – P) - Rw

TABULATION:

Parameter	Diameter *(mm)*	Std. Reading 'R_s' *(mm)*	Work Piece Reading 'R_w' *(mm)*	Diameter	
				Max. *(mm)*	Min. *(mm)*
Major Diameter					
Minor Diameter					
Effective Diameter					

RESULT:

1. Major diameter of the specimen = ----------
2. Minor diameter of the specimen = ----------
3. Effective diameter of the specimen = ----------

Thus the minor, major and effective diameters of specimen are measured by using Floating Carriage Micrometer.

OUTCOME:

Students will be able to determine the various parameters of thread using Floating Carriage Micrometer.

APPLICATIONS:

Gauge dimensions such as outside diameter, pitch diameter, and root diameter are measured with the help of this instrument.

EX. NO.: 6	MEASUREMENT OF GEAR TOOTH SPECIFICATIONS BY USING GEAR TOOTH VERNIER CALIPER	DATE:

AIM:

To measure the thickness and depth of the gear using Gear Tooth Vernier.

APPARATUS REQUIRED:

- Gear tooth Vernier
- Specimen - spur gear

DESCRIPTION:

Gear tooth Vernier is also a type of Vernier used to measure the depth between the gears and thickness of the tooth in a same operation. This gear tooth Vernier having separate main scale and Vernier scale for the measurement of thickness and depth. The lower main scale and sliding Vernier scale in horizontal direction is used to measure the thickness of the teeth. The main scale and Vernier scale in vertical direction is used to measure the depth between teeth.

PROCEDURE:

1. Calculate chordal thickness W and chordal addendum d using the following formula:

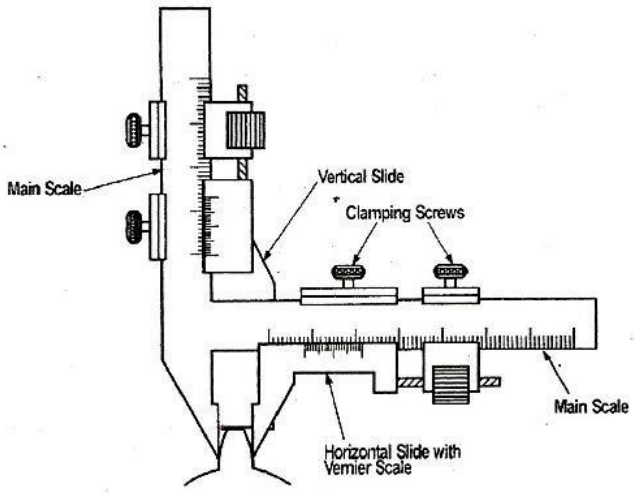
Chordal thickness (W) $= N \times m \sin(90/N)$

Depth (d) $= N \times m/2\,[1 + 2/n - \cos 90/N]$

where N is the number of teeth and m is the module.

2. Determine the error in the chord with a gear tooth vernier caliper.
3. Determine the error in the instrument in the vertical and horizontal vernier jaws coinciding with mainframe
4. Note down the error
5. Adjust the vertical vernier jaw for the chordal addendum d and place the tongue over the space of the gear tooth (i.e., d + error value)
6. Measure the gear tooth thickness w in a manner similar to the measurement by a conventional caliper

DIAGRAM:



TABULATION

Gear Tooth Number	Main Scale Reading *(mm)*	Vernier Scale Reading *(mm)*	Measured Value *(mm)*
GEAR TOOTH DEPTH:			
1			
2			
3			
GEAR TOOTH THICKNESS:			
1			
2			
3			

RESULT:

i. Gear tooth thickness = ----------

ii. Gear tooth width = ----------

Thus the thickness and depth of the gear using Gear Tooth Vernier is measured.

OUTCOME:

Students will be able to select proper measuring instrument for measuring gear tooth thickness.

APPLICATIONS:

Measuring hobs, form and thread tools.

EX. NO.: 7	MEASUREMENT OF GEAR TOOTH SPECIFICATIONS BY USING TOOL MARKER'S MICROSCOPE	DATE:

AIM:

To measure the major diameter, minor diameter, and pitch of the given screw thread using a tool marker's microscope.

APPARATUS REQUIRED:

- Tool maker's microscope
- Steel scale
- Specimen screw

DESCRIPTION:

A large tool maker's microscope, shown in Fig., essentially consists of a cast base, the main lighting unit, the upright with carrying arm, and the sighting microscope. The rigid cast base rests on three foot screws by means of which the equipment can be leveled with reference to the build-in box level. The base carries the coordinate measuring table, consisting of two measuring slides, one along the X and the other along the Y direction, and a rotary circular table provided with a glass plate. The slides run on precision balls in hardened guide ways warranting reliable travel. Two micrometer screws, each of them measuring a specified range given by the equipment manufacturer, permit the measuring table to be displaced in the directions X and Y. The range of movement of the carriage can be widened up to 150 mm in the X direction and up to 50 mm in the Y direction with the use of gauge blocks.

PROCEDURE:

The steps to be adopted for the experimental procedure are as follows:
1. Clamp the given screw thread on the table keeping the axis approximately horizontal
2. Move the microscope in the X and Y directions to the vicinity of the screw thread profile
3. Adjust the optical head for focusing the screw thread profile at the cross-wires.

(i). Measurement of Major or Outer Diameter
The major or outer diameter can be measured in the following way:
1. Coincide the horizontal cross-wire to the crest (outermost point) of the screw thread profile. Note down the reading (IR)
2. Move the optical head along the Y-axis and coincide the horizontal cross-wire with the outermost point on the other side of the profile. Note down the reading (FR)
3. The difference between initial reading and final reading gives the major diameter.

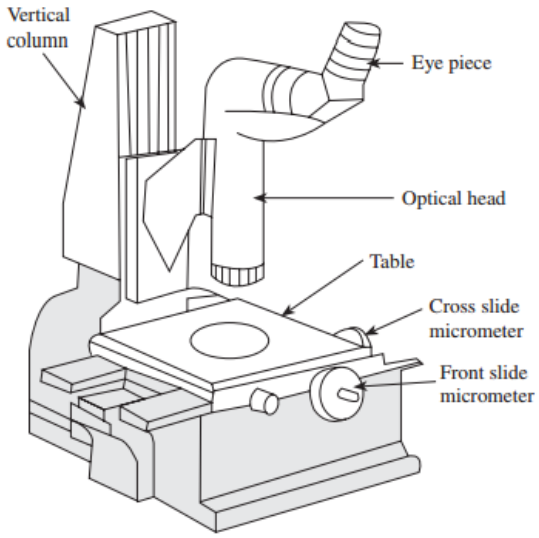
(ii). Measurement of Inner or Minor Diameter
The inner or minor diameter can be measured in the following way:
1. Coincide the horizontal cross-wire with the root of the screw thread profile. Note down the reading (IR)
2. Move the optical head along the Y-axis and coincide the horizontal cross with the root of the screw thread on the other side
3. The difference between final reading and initial reading gives the inner or minor diameter

(iii). Measurement of Pitch

The steps involved in pitch measurement are as follows:

1. Coincide the vertical cross-wire approximately with the line of symmetry passing through the screw thread, apex, or notch. Note down the reading (IR)
2. Move the optical head along the X-axis and coincide the cross-wire with the adjacent screw thread. Note down the reading (FR).
3. The difference between initial reading and final reading gives the pitch of the screw thread. The experimental results are documented in Table.

DIAGRAM:



TABULATION:

Parameter	Trial No.	Initial Reading (IR)	Final Reading (FR)	Difference (IR-FR)	Average (mm)
Outer Diameter (D)	1				
	2				
Inner Diameter (d)	1				
	2				
Pitch (p)	1				
	2				

RESULT:

i. Major diameter = ----------
ii. Minor diameter = ----------
iii. Pitch = ----------

Thus the major diameter, minor diameter, and pitch of the given screw thread are measured using a tool marker's microscope.

OUTCOME:

Students will be able to measure the various dimensions of the given gear specimen using tool maker's microscope.

APPLICATIONS:

1. Machine Shop
2. Quality Department

EX. NO.: 8	MEASUREMENT OF GEAR TOOTH SPECIFICATIONS BY USING PROFILE PROJECTOR	DATE:

AIM :

To measure the elements of a given spur gear using a profile projector.

APPARATUS REQUIRED:

- Profile Projector.
- Specimen.

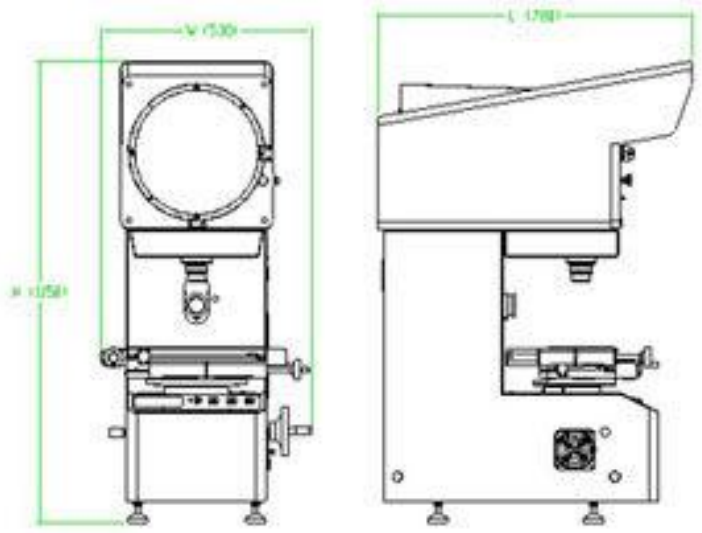
DESCRIPTION:

Profile projector is a relatively simple and accurate instrument to measure the thread parameters. Initially the micrometer reading is set to zero on the scale and the indicator is moved along to bring the stylus and the indicator is adjusted radially until the stylus engages between the thread flanks. A light source provides horizontal beam of light which is reflected from a mirror by 90^o upwards towards the table.

PROCEDURE:

- Work piece is placed on the glass by means of light source horizontal beam of light source is affected from a mirror by 90^o upwards towards the table.
- By adjusting the clamping screw the clear image of the outline of work piece is reduced through optical head.
- By adjusting the micrometer screw for lateral movement of table selecting the flank of the screw thread on the horizontal cross wire.
- Screw can be rotated to find out the thread angle and flank angle.

DIAGRAM:



TABULATION:

(i) Major Diameter:

Position	Main Scale Reading *(mm)*	Thimble Scale Reading *(mm)*	Measured Val = MSR+ (TSR×LC) *(mm)*	Initial - Final Reading *(mm)*
Initial				
Final				

(ii) Minor Diameter:

Position	Main Scale Reading *(mm)*	Thimble Scale Reading *(mm)*	Measured Val = MSR+ (TSR×LC) *(mm)*	Initial - Final Reading *(mm)*
Initial				
Final				

(iii) Angle:

Position	Main Scale Reading *(mm)*	Thimble Scale Reading *(mm)*	Measured Val = MSR+ (TSR×LC) *(mm)*	Initial - Final Reading *(mm)*
Initial				
Final				

(iv) Pitch:

Position	Main Scale Reading *(mm)*	Thimble Scale Reading *(mm)*	Measured Val = MSR+ (TSR×LC) *(mm)*	Initial - Final Reading *(mm)*
Initial				
Final				

(v) Height:

Position	Main Scale Reading *(mm)*	Thimble Scale Reading *(mm)*	Measured Val = MSR+ (TSR×LC) *(mm)*	Initial - Final Reading *(mm)*
Initial				
Final				

RESULT:

a) Major diameter = ---------- *mm*

b) Minor diameter = ---------- *mm*

c) Angle = ---------- *mm*

d) Pitch = ---------- *mm*

e) Height = ---------- *mm*

OUTCOME:

Students will be able to understand the projector magnification of the profile of the specimen, and how the image ratio differs with the distance of the projection screen.

APPLICATIONS:

1. Measurement of Screw
2. Quality Department

EX. NO.: 9	MEASUREMENT OF SURFACE ROUGHNESS USING SURFACE ROUGHNESS TESTER	DATE:

AIM:

To measure the surface roughness parameters such as Rz , Ra , Rq and Rt are measure using surface roughness tester.

APPARATUS REQUIRED:

1. Surface Roughness Tester
2. Standard work piece

DESCRIPTION:

A surface roughness tester is required to assign a numerical value to the degree of surface roughness. This will enable the analyst to assess whether the surface quality meets the functional requirements of a component. A typical surface roughness tester is shown in Fig. Various methodologies are employed to arrive at a representative parameter of surface roughness.

PROCEDURE:

The experimental procedure can be carried out in the following way:
1. Select the measuring range, evaluation length, and cut-off value, depending on the surface to be measured.
2. Choose the pickup system that is suited for the application.
3. Carry out a freehand measurement of the specimen surface.
4. Transfer the data to a computer (if available); the tester is also capable of storing a minimum of 10 records.
5. Generate the required surface roughness values and record the results in the format shown in Table.

DIAGRAM:

TABULATION:

Sl. No.	Specimen Type	Arithmetic Mean Value of Surface Roughness (R_a) *(Microns)*	Root Mean Square Value of Surface Roughness (R_q) *(Microns)*	Ten-Point Mean Surface Roughness (R_z) *(Microns)*	Peak to Valley Height of Surface Roughness (R_t) *(Microns)*
1					
2					
3					
4					
5					

RESULT:

Thus the surface roughness parameters Rz , Ra , Rq and Rt are measure using surface roughness tester.

a) Rz = ---------- microns
b) Ra = ---------- microns
c) Rq = ---------- microns
d) Rt = ---------- microns

OUTCOME:

Student will become familiar with the Surface Roughness instrument that is available for roughness measurements.

APPLICATIONS:

1. Quality Department

EX. NO.: 10	MEASUREMENT OF FORCE USING FORCE MEASURING SETUP	DATE:

AIM:

To measure the applied force using Force measuring setup.

APPARATUS REQUIRED:

1. Proving Ring
2. Load Cell
3. Force Indicator
4. Screw Jack
5. Dial Gauge.

Capacity of proving Ring =2.5 KN.

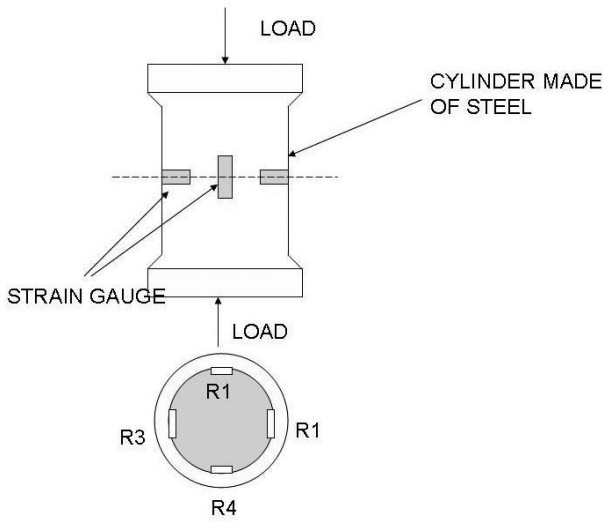
DESCRIPTION:

Force is one of the major derived parameter having fundamental dimension of mass length and time. It is a vector quantity which, when applied result in a change of momentum in a body. Basically mechanical force is created due to variation of started potential energy. This is different types of load cell like column type, shear type, s-type, and compression type. In this setup, s-type load cell is provided.

PROCEDURE:

1. Ensure that proving ring along with load all is perfectly in vertical position.
2. Check and ensure that the axis of screw jacks perfectly aligned with load cell.
3. Ensure that load cell with socket is connected to the rear side of the load indicator.
4. Apply a small load without any slip in the system.
5. Note down the reading of dial gauge of force indicator.

DIAGRAM:



TABULATION:

Sl. No.	Actual Force *(N)*	Observed Force *(N)*
1		
2		
3		
4		
5		

RESULT:

Thus the force is measured using Force measuring setup.

OUTCOME:

Students will be able to understand the Sensor device (electro-mechanical) which helps to measure a physical parameter such as force by providing analog input to get digital output.

APPLICATIONS:

1. Machine Shop
2. Automobile

EX. NO.: 11	MEASUREMENT OF STRAIGHTNESS USING AUTOCOLLIMATOR	DATE:

AIM:

To measure the straightness of a given specimen using two axis Autocollimator.

APPARATUS REQUIRED:

1. Collimator unit
2. Base
3. Plain Reflector
4. Optical Scanner

PROCEDURE:

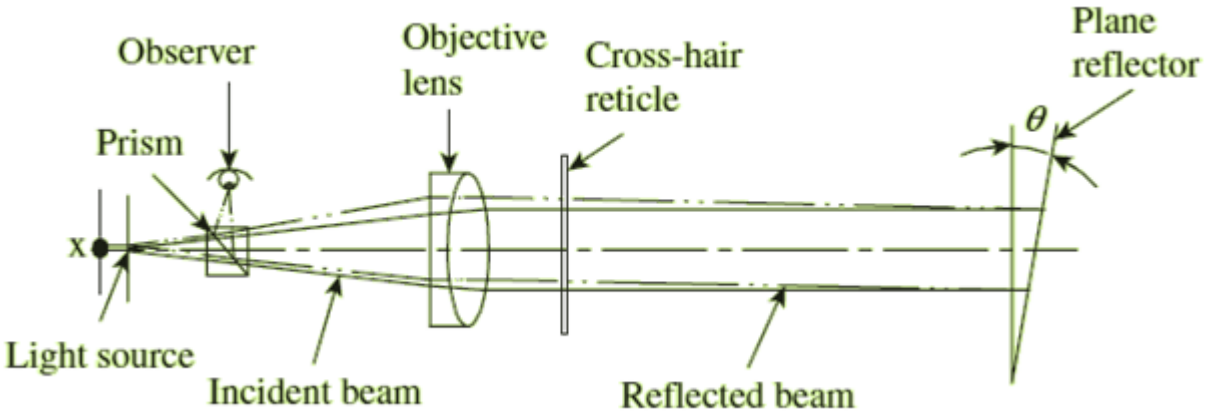
1. Testing square with auto collimator.
2. Level auto collimator unit on a stand a table.
3. Straighten the light.
4. Observe measuring graphical through the eye below.
5. The smallest discussion of linear scale is measured.
6. Bring plain reflector in front of the auto collimator to get reflector.
7. Depending upon the verification in surface.
8. Using micrometer provided for eye piece we can measure the frequency up in lose.

FORMULA:

Deviation = Sin θ (A-B)

Where angle θ in rad & Distance A-B in mm

DIAGRAM:



TABULATION:

(i). PARALLEL TO THE AXIS:

Sl. No.	Distance from ref A-B *(mm)*	Main Scale Reading *(Min)*	Micrometer *(Sec)*	Result - θ degree	Deviations *(mm)*
1					
2					
3					
4					
5					

(ii). PERPENDICULAR TO THE AXIS:

Sl. No.	Distance from ref A-B *(mm)*	MSR *(Min)*	Micrometer *(Sec)*	Result - θ degree	Deviations *(mm)*
1					
2					
3					
4					
5					

RESULT:

Thus the straightness of a given specimen is measured by using two axis Autocollimator.

OUTCOME:

Students will be familiar with measurement of flatness and straightness using Autocollimator.

APPLICATIONS:

1. Surface Roughness
2. Quality Department

EX. NO.: 12	MEASUREMENT OF TEMPERATURE USING THERMOCOUPLE	DATE:

AIM:

To measure the temperature using Thermocouple setup.

APPARATUS REQUIRED:

1. Thermocouple
2. Temperature Measuring Setup.

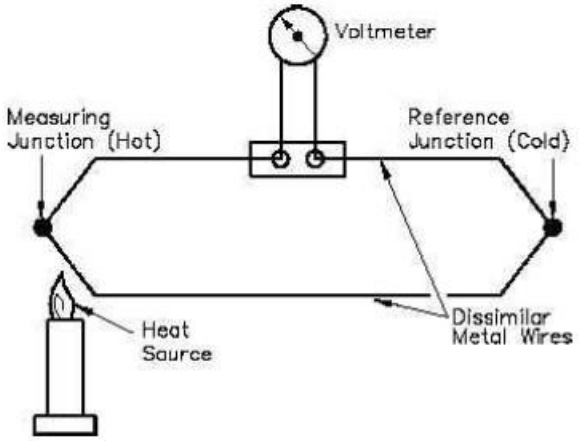
DESCRIPTON:

Thermocouple is the simplest and commonly used methods of measuring process temperature. The operation of Thermocouple is based on seebeck effect. See back discovered that when heat is supplied to the junction of two dissimilar metals, an EMF is generated which can be measured at the other junction. The two dissimilar metals form an electric circuit and current flows as a result of the generated EMF.

PROCEDURE:

1. Connect the thermocouple supplied at the impute terminal if copper constantan Thermocouple is used.
2. Copper wire must be connected to the terminal and constantan wire to –ve terminal.
3. Immerse the junction of thermocouple in ice and adjust the meter reading at 0° C using potentiometer.
4. Immerse the junction of thermocouple in boiling at 98° C by using potentiometer marked max.
5. Repeat the procedure for 2 to 3 times.

DIAGRAM:



TABULATION:

Sl. No.	Actual temperature °C	Indicated temperature °C
1		
2		
3		
4		
5		

RESULT:

Thus the temperature measurement is carried out using Thermocouple.

OUTCOME:

Students will be able to familiar with the temperature measurement using Thermocouple.

APPLICATIONS:

Temperature measurement for kilns, gas turbine exhaust, diesel engines, and other industrial processes.

EX. NO.: 13	MEASUREMENT OF TORQUE USING TORQUE MEASURING SETUP	DATE:

AIM:

To measure the applied torque using Torque measuring setup.

APPARATUS REQUIRED:

1. Torque Measurement Equipment
2. Stand
3. Lever
4. Stain Gauge
5. Weight.

DESCRIPTION:

Torque is the tangential force to set a body in rotation. It is represented as a vector of a force for a rigged body undergoing force rotation about a single axis.

Torque = Force x Distance

Thus torque is the essential tensional twisting about its axis of rotation. In this setup shear type load is used to measure the torque a inverse method of measuring the load with the output immune to side load and bending moment is based on measurement of shear components. The load cell is balancing a beam supported on both ends.

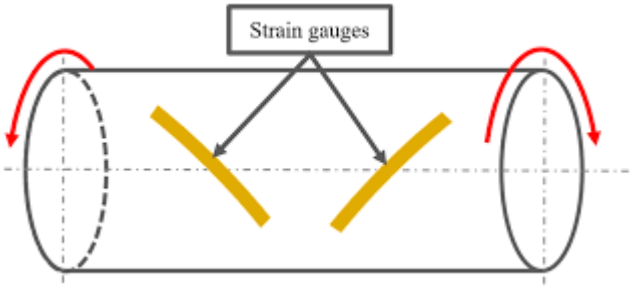
PROCEDURE:

1. Fix the main frame of transducers rigidity.
2. Connect the cantilever beam with weight pan.
3. Connect transducer wire socket to rear side of indicator.
4. Connect digital indicator at 230V, AC supply.
5. Set zero on indicator, by zero adjust pan provides indicator.
6. Now apply the load gradually and note down reading in upward & downward trend.

FORMULA USED:

Calculated Torque = Load x Distance (kg-m)

DIAGRAM:



TABULATION:

(ii).Distance: 1 meter

Sl. No.	Weight added (Kg)	Observed torque *(Kg-m)*	Calculated Torque *(Kg-m)*
1			
2			
3			
4			
5			

(iii).Distance: 0.5 meter

Sl. No.	Weight added (Kg)	Observed Torque *(Kg-m)*	Calculated Torque *(Kg-m)*
1			
2			
3			
4			
5			

RESULT:

Thus the applied torque is measured using Torque measuring setup.

OUTCOME:

Students will be able to understand the Sensor device (electro-mechanical) which helps us to measure the torque in-terms of strain by providing analog input to digital output.

APPLICATIONS:

1. Machine Shop
2. Turbine

EX. NO.: 14	MEASUREMENT OF DISPLACEMENT USING LINEAR VARIABLE DIFFERENTIAL TRANSDUCER (LVDT)	DATE:

AIM:

To measure the displacement using LVDT.

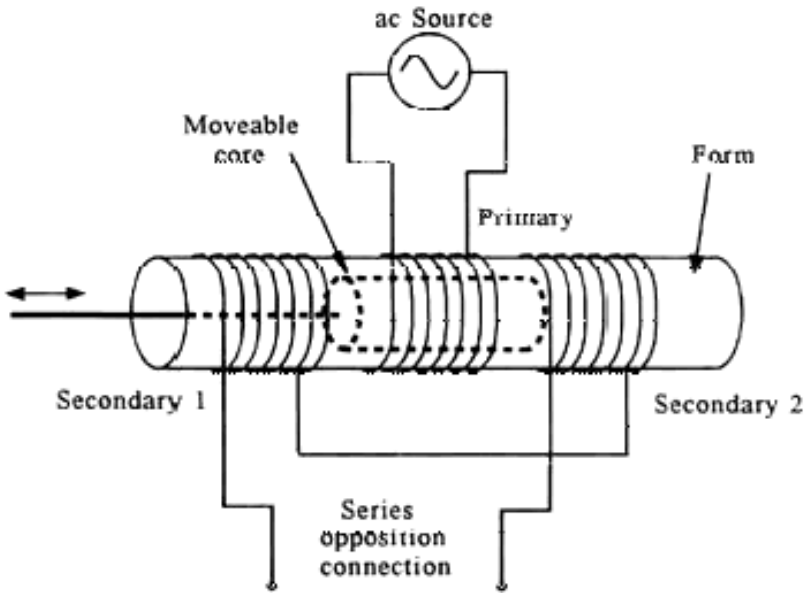
APPARATUS REQUIRED:

1. LVDT

PROCEDURE:

1. Plug the power chard to AC main 230v/50Hx & Switch on the instrument.
2. Plate RED/CAL switch at read position.
3. Balance the amplifier with the help of zero knobs. Without connecting LVDT to instruments.
4. Replace the RED/CAL switch at CAL position.
5. Adjust the calibration point by rotating CAL knob so display should read 10.00 (i.e.) maximum ranges.
6. Again keep the RED/CAL switch at read position and connect the LVDT cable to instruments.
7. Mechanical zero by rotating the micrometer. Display will read zero this is full balancing.
8. Give displacement with micrometer and observe the digital reading.
9. Plot the graph of micrometer reading.

DIAGRAM:



TABULATION:

SL.NO.	PUSH SIDE		PULL SIDE	
	MICROMETER READING *(mm)*	**INDICATED READING *(mm)***	**MICROMETER READING *(mm)***	**INDICATED READING *(mm)***
1				
2				
3				
4				
5				

RESULT:

Thus the displacement is measured by using LVDT.

OUTCOME:

Students will be able to understand about the LVDT and how the electromechanical sensor used to convert mechanical motion.

APPLICATIONS:

It act as a secondary transducer, it is used to measure force, weight and pressure.

EX. NO.: 15	BORE DIAMETER MEASUREMENT USING TELESCOPE GAUGE	DATE:

AIM:

To find the internal diameter of a hole for a given specimen.

APPARATUS REQUIRED:

1. Telescope Gauge
2. Standard work piece
3. Vernier Caliper

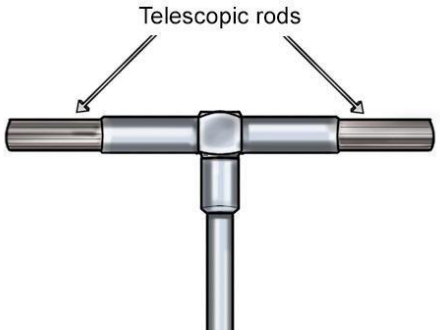
DESCRIPTION:

It is used for measuring internal diameter of a hole, which is machined. The bore dial gauge consists of one fixed measuring head and one movable measuring head. The movement of the movable measuring rod is transmitted to dial indicator by push rod through a spring actuated hinged member. Thus the horizontal movement of the rod is transmitted into vertical direction gives indication of variation of size. The calibrated rods are made in different sizes and sometimes number of short rods threaded at the ends are used in combination to get different desired lengths

PROCEDURE:

The measuring head is placed in contact with the surface of hole & movement of measuring head contact point is transmitted to the amplifying mechanism by the calibrated rods and it's shown on the dial indicator. These calibrated rods are located in tabular supports between the head and dial units. The readings from dial indicator are tabulated

DIAGRAM:



TABULATION:

SL. NO.	**ACTUAL DIAMETER** ***(Using Vernier Caliper)*** ***(mm)***	**TRAIL 1** ***(Using Telescope Gauge)*** ***(mm)***	**TRAIL 2** ***(Using Telescope Gauge)*** ***(mm)***	**AVERAGE MEASURED DIAMETER** ***(mm)***
1				
2				
3				
4				
5				

RESULT:

The internal diameter of a hole for a given components are measured using Telescope Gauge.

OUTCOME:

Students will be able to determine the diameter of bore by using telescopic gauge

APPLICATIONS:

1. Automobile
2. Quality Department

E.G.S. PILLAY ENGINEERING COLLEGE
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Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai Accredited by NAAC with "A" Grade | Accredited by NBA (CSE, EEE, MECH)

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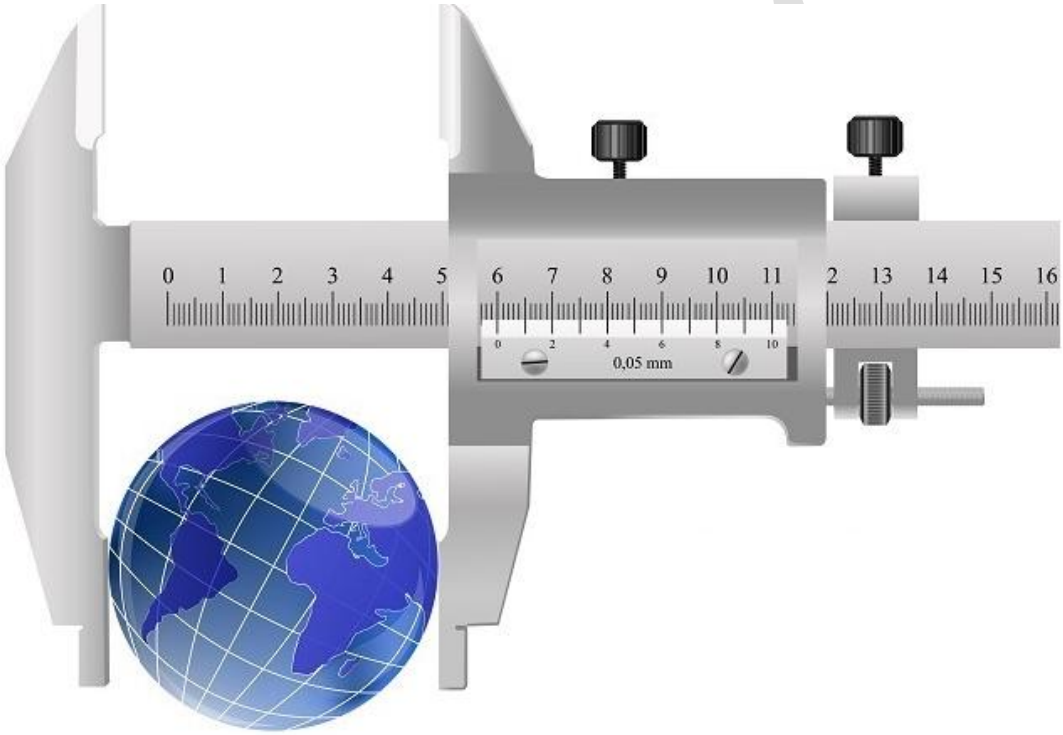
DEPARTMENT OF MECHANICAL ENGINEERING



IV SEMESTER

1702ME402 - MEASUREMENTS AND METROLOGY LABORATORY

LAB VIVA QUESTIONS

INTRODUCTION TO METROLOGY

Viva Questions and Answers

1. **What is Range of measurement?**
   The physical variables that are measured between two values. One is the higher calibration value H, and the other is Lower value L, The difference between H, and L, is called range.

2. **Give any four methods of measurement**
   1. Direct method 2.Indirect method 3.Comparison method 4.Coincidence method.

3. **What is accuracy?**
   Accuracy - The maximum amount by which the result differ from true value.

4. **What is Precision?**
   Precision - Degree of repetitiveness. If an instrument is not precise it will give different results for the same dimension for the repeated readings.

5. **What is the basic Principle of measurement?**
   It is the physical phenomenon utilized in the measurement. If energy kind of quantity measured, there must be a unit to measure it. So this will give the quantity to be measured in number of that unit.

6. **What is Resolution:**
   The minimum value of the input signal is required to cause an appreciable change in the output known as resolution.

7. **Define: Measurand.**
   Measurand is the physical quantity or property like length, diameter, and angle to be measured.

8. **Define: Deterministic Metrology.**
   The metrology in which part measurement is replaced by process measurement. The new techniques such as 3D error compensation by CNC systems are applied.

9. **Define True size:**
   True size is Theoretical size of a dimension.

10. **Define Actual size**
    Actual size = Size obtained through measurement with permissible error.

MEASUREMENT OF COMPONENTS USING VERNIER CALIPER

Viva Questions and Answers

1. **What are the various types of linear measuring instruments?**
   i.Vernier calipers ii. Micrometers iii. Slip gauge or gauge blocks iv. Comparator

2. **List the various linear measurements?**
   (i) Length (ii) Heights and (iii) Thickness

3. **What is vernier caliper?**
   Vernier caliper is a linear measuring instrument. It is used to measure the dimensions like length, width and thickness of the components.

4. **What is Least Count (L.C.)?**
   The least value that can be measured by using any measuring instrument known as least count.

5. **What is the Least Count for Vernier Caliper?**
   Least count of a Vernier Caliper is 0.02 mm.

6. **Classify the Absolute error.**
   The absolute error is classified into 1. True absolute error 2. Apparent absolute error

7. **What is Relative error.**
   Relative error is defined as the results of the absolute error and the, value of comparison used for calculation of that absolute error. The comparison may be true value or conventional true value or arithmetic mean for series of measurement.

8. **What is LEGAL METROLOGY**
   Legal metrology is part of Metrology and it is directed by a National Organisation which is called "Notional service of Legal Metrology". The main objective is to, maintain uniformity of measurement in a particular country.

9. **How to calibrate Vernier caliper?**
   To **calibrate** the internal jaws, set them to 0.500 inch (12.7 mm) and use the locking screw to fix their position. Then use another calibrated **vernier caliper** to measure the distance between the jaws. Record the readings and compare. Take multiple readings for more accuracy.

10. **When in the zero error in the caliper is positive?**
    Zero error is '+' ve if on making the jaws of vernier caliper touch each other the zero of the vernier scale lies to the right f zero of the main scale.

MEASUREMENT OF COMPONENTS USING VERNIER HEIGHT GAUGE

Viva Questions and Answers

1. **What is vernier Height Gauge?**
   A height gauge is a measuring device used either for determining the height of objects, or for marking of items to be worked.

2. **What are the applications of Vernier Height Gauge?**
   Height gauges may also be used to measure the height of an object by using the underside of the scriber as the datum.

3. **What is Least Count (L.C.)?**
   The least value that can be measured by using any measuring instrument known as least count.

4. **What is the Least Count for Vernier Height Gauge?**
   Least count of a Vernier Height Gauge is 0.02 mm

5. **What is the need of inspection?**
   To determine the fitness of new made materials, products or component part and to compare the materials, products to the established standard.

6. **Explain the functions of Scriber?**
   i. To measure the height ii. To mark in the object

7. **What is Resolution?**
   The minimum value of the input signal is required to cause an appreciable change in the output known as resolution.

8. **Define system error and correction.**
   Error: The deviation between the results of measured value to the actual value.
   Correction: The numerical value which should be added to the measured value to get the correct result.

9. **What is Hysteresis?**
   All the energy put into the stressed component when loaded is not recovered upon unloading. So, the output of measurement partially depends on input called hysteresis.

10. **Explain the term magnification.**
    It means the magnitude of output signal of measuring instrument times increases to make it more readable.

MEASUREMENT OF COMPONENTS USING VERNIER DEPTH GAUGE

Viva Questions and Answers

1. **What is vernier Depth Gauge?**
   A Depth gauge is a measuring device used either for determining the Depth of holes in the specimens.

2. **What is Least Count (L.C.)?**
   The least value that can be measured by using any measuring instrument known as least count.

3. **What is the Least Count for Vernier Depth Gauge?**
   Least count of a Vernier Height Gauge is 0.02 mm

4. **What is calibration?**
   Calibration is the comparing of an unknown measurement device against equal or better known standard under specified conditions. Every measuring system must be provable. The procedure adopted to prove the ability of a measuring system to measure reliably is called 'calibration'.

5. **Define Accuracy.**
   Accuracy of an instrument indicates the deviation of the reading from a known input.

6. **What is the least count of digital Vernier caliper?**
   The least count error is the error associated with the resolution of the instrument. If we use a metre scale for measurement of length, it may have graduations at 1 mm division scale spacing or interval. A Vernier scale on caliper may have a least count of 0.02 mm while a micrometer may have a least count of 0.01 mm.

7. **What is the difference between Vernier Height Gauge, Vernier Depth Gauge, and Vernier Caliper?**
   The micrometer screw gauge is used to measure even smaller dimensions than the vernier calipers. The micrometers in our laboratory have a pitch of 0.50 mm. The rotating thimble is subdivided into 50 equal divisions

8. **Name some linear measuring devices?**
   Non-precision instruments include steel rule, caliper divider, and telescopic gauge that are used to measure to the line graduations of a rule. Precision instruments include micrometers, vernier calipers, height gauges and slip gauges.

9. **Write the applications of Vernier Depth Gauge**
   A depth gauge is used to measure the depth of a slot, hole or any other surface of an object. It can be of scale, dial or digital type.

10. **What are the applications of Legal metrology?**
    1. Industrial Measurement 2. Commercial transactions 3. Ensuring public health and human safety

MEASUREMENT OF COMPONENTS USING MICROMETER

Viva Questions and Answers

1. **List the various linear measuring instruments.**
   a) Scale b) Vernier Calipers c) Height Gauge d) Micrometer etc.

2. **What is Micrometer**?
   A micrometer is a tool used for the precise measurement of very small objects.

3. **Explain any four different types of Micrometer?**
   i. Inside MM ii. Outside MM iii. Thread MM iv. Depth MM

4. **What is the Least Count for Micrometer?**
   Least count of a Micrometer is 0.01 mm.

5. **How to maintain constant pressure in Micrometer?**
   By rotating the Ratchet providing at the end of thimble portion.

6. **What is mean by pitch of a screw?**
   Pitch is the distance between two nearest (consecutive and successive) threads along the axis screw.
7. **What is the principle of screw gauge?**
   The line distance moved by the screw directly proportional to the rotation given to the head.

8. **What metal used in making screw and why?**
   The screw is made up of gun metal to avoid wear and tear after long use.

9. **What is backlash error in micrometer?**
   With in a nut there is a little space for the play of screw. Due to continuous use this space increases. Thus when the screw is turned in one direction the stud moves as usual. However when the screw is rotated in opposite direction, the stud does not move for a while this error is called backlash error.

10. **Name the various methods used for measuring the major diameter**
    (i) Ordinary micrometer (ii) Bench micro meter

CHECKING THE LIMITS OF DIMENSIONAL TOLERANCES USING MECHANICAL COMPARATOR

Viva Questions and Answers

1. **What is comparator?**
   Comparators are one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions.

2. **Classify the comparator according to the principles used for obtaining magnification.**
   The common types are: (i) Mechanical comparators. (ii) Electrical comparators. (iii) Optical comparators. (iv) Pneumatic comparators.

3. **How the mechanical comparator works?**
   The method of magnifying small movement of the indicator in all mechanical comparators are effected by means of levers, gear trains or a combination of these elements.

4. **State the best example of a mechanical comparator.**
   A dial indicator or dial gauge is used as a mechanical comparator.

5. **Define least count and mention the least count of a mechanical comparator.**
   Least count - The least value that can be measured by using any measuring instrument known as least count. Least count of a mechanical comparator is 0.0 1 mm

6. **Mention any two disadvantages of reed type mechanical comparator.**
   (i) Accuracv of the comparator mainly depends on the accuracy of the rack and pinion arrangement. Any slackness will reduce accuracy.
   (ii) It has more moving parts and hence friction is more and accuracy is less.

7. **What are the major types of on electrical comparator?**
   An electrical comparator consists of the following three major parts such as
   (i) Transducer (ii) Display device as meter (iii) Amplifier

8. **On what basis the transducer works?**
   An iron armature is provided in between two coils held by a leaf spring at one end. The other end is supported against a plunger. The two coils act as two arms of an A.C. wheat stone bridge circuit.

9. **How is the accuracy of an electrical comparator checked?**
   To check the accuracy of a given specimen or work, first a standard specimen is placed under the plunger. After this, the resistance of wheat stone bridge is adjusted that the scale reading shows zero. Then the specimen is removed. Now, the work is introduced under the plunger.

10. **State the working principle of an electronic comparator.**
    In electronic comparator, transducer induction or the principle of application of frequency modulation or radio oscillation is followed

MEASUREMENT OF TAPER ANGLE USING SINE BAR AND SLIP GAUGE

Viva Questions and Answers

1. What is a sine bar?

Sine bar is a high precision & most accurate angle measuring instrument. It is used for measurement of an angle of a given job or for setting an angle. It can be used in conjunction with set of angle gauges and dial gauge for measurement of angles and tapers from horizontal surface.

2. What is a sine center?

These are used in situations where it is difficult to mount the component on the sine bar. It is basically used for conical work pieces. It is the extension of sine bars where two ends are provided on which centers can be Clamped. These are useful for testing of conical work centered at each end, up to 60°.

3. What are the limitations of Sine Bar?

It cannot be used when the angle less than 15 degrees and more than 45 degrees.

4. What are slip gauges and why do we use them?

Slip Gauges are known as Gauge Blocks. They are Precise Measuring instruments. These Slip Gauges are universally accepted end Standard of length.

5. What are the modifications of Sine Bar?

Sine centre is the modified sine bar device which measures small angles with enough accuracy to calibrate precision optical autocollimators.

6. Define Parallelism.

The condition of a surface line or axis which is equidistant at all from a datum plane or axis.

7. What is the principle of Sine Bar?

When a sine bar is placed on level surface the top edge will be parallel to that surface. If one roller is raised by a known distance, usually using gauge blocks, then the top edge of the bar will be tilted by the same amount forming an angle hat may be calculated by sine rule.

8. What is a use of gauge block?

A gauge block is a block of metal o ceramic with two opposing faces ground precise distance apart. Standard grade block are made of a hardened steel alloy, when calibration grade blocks are often made of tungsten carbide or chromium carbide.

9. What are the limitations of Sine Bar?

- The accuracy of sine bar is limited to the centre distance of two precision rollers.
- Limitation in the use of sine bar as primary standard of angle.
- Not fairly reliable at angles less than 15^0

10. What are the sources of errors in Sine Bar?

- Errors in distance between the rollers.
- Errors in parallelism between the gauging surfaces.
- Errors in parallelism of roller axes with each other.
- Errors in flatness of the upper surface of the bar.

MEASUREMENT OF THREAD PARAMETERS BY USING FLOATING CARRIAGE MICROMETER

Viva Questions and Answers

1) **Name the various types of pitch errors found in screw?**
   (i) Progressive error (ii) Drunken error (iii) Periodic error (iv) Irregular errors.

2) **Name the various methods of measuring the minor diameter of the thread.**
   i. using taper parallels ii. Using rollers and slip gauges

3) **Name the various methods for measuring effective diameter.**
   (i) One wire method (ii) Two wire method (iii) Three wire method.

4) **What is best size of wire?**
   Best size of wire is a wire of such diameter that it makes contact with the flanks of the thread on the pitch line.

5) **Define Drunken thread.**
   This is one, having erratic pitch, in which the advance of the helix is irregular in one complete revolution of thread.

6) **Name the various methods used for measuring the major diameter**
   (i) Ordinary micrometer (ii) Bench micro meter

7) **Name the various methods for measuring effective diameter.**
   (i) One wire method (ii) Two wire method (iii) Three wire method.

8) **Name the various methods for measuring pitch diameter.**
   (i) Pitch measuring machine (ii) Tool maker ic (iii) Screw pitch gauge.

9) **Name the two corrections are to be applied in the measurement of effective diameter.**
   (i) Rake corrections (ii) Compression correction

10) **What are the various characteristics that you would measure in a screw thread?**
    Major, Minor and effective diameters, Pitch, Angle.

MEASUREMENT OF GEAR PARAMETERS USING GEAR TOOTH VERNIER

Viva Questions and Answers

1. **Define – Tooth thickness**
   Distance of the tooth measured along the circumference of the pitch circle is known as tooth thickness.

2. **Define – Addendum.**
   Distance between the pitch circle to the top of the tooth in radial direction is known as addendum.

3. **Define – Dedendum.**
   Distance between the pitch circle to the bottom of the tooth in radial direction, is known as dedendum of the gear.

4. **Define – face width.**
   It is the width of the gear tooth measured parallel to its axis.

5. **Define – Profile.**
   It is the curve formed by the face and flank of the tooth

6. **Define – Pitch Circle.**
   It is an imaginary circle which is in pure rolling action. The motion of the gear is describe by the pitch circle motion.

7. **Define – Pitch Circle diameter.**
   The diameter of the pitch circle from the center of the gear is known as pitch circle diameter. The gear diameter is described by its pitch circle diameter.

8. **Define – Module.**
   The ratio of the pitch circle diameter in millimeters to the total number of teeth is known as module. It is reciprocal of the diametrical pitch.

9. **Define – total depth.**
   It is the radial distance between the addendum and the dedendum circles of a gear. It is equal to the sum of the addendum and dedendum.

10. **Define – Backlash.**
    It is the difference between the tooth thickness and the tooth space. It prevents jamming of the gears in meshing condition.

TO MEASURE THE MAJOR DIAMETER, MINOR DIAMETER, AND PITCH OF THE GIVEN SCREW THREAD USING A TOOL MARKER'S MICROSCOPE

1) What is meant by tool maker's microscope?

It works on the principle of a screw gauge, but a few changes were added to it to make its operation easier. Also it is a measuring device that can be used to measure up to 1/100th of an mm.

2) What is the light used in tool maker's microscope?

The **toolmaker's microscope** is an **optical** measuring machine equipped for external & internal length measurements as well as measurements on screw threads, profiles, curvatures & angles.

3) What are the various characteristics that you would measure in a screw thread?

Major, Minor and effective diameters, Pitch, Angle.

4) What are the instruments that are required for measuring screw thread?

The major diameter of **screw thread** may be **measured** by micrometer or vernier calliper. For greater accuracy and convenience, the major diameter is **measured** by a bench micrometer.

5) Define – Pitch

The **thread pitch** is the distance between **threads** expressed in millimeters (measured along the length of the fastener). For example a **thread pitch** of 1.5 means that the distance between one **thread** and the next is 1.5mm.

6) What are the causes of pitch error?

One is error within the rotation, known as drunken thread, because of slight thread waver over the course of a rotation. The other is slip-stick, or backlash, which is caused by unwanted slop between the mesh of the threads. This is a common cause of reversal errors.

7) What is progressive error?

The pitch of the thread is uniform but is longer or shorter its nominal value and this is called progressive error.

8) What are the applications of tool maker's microscope?

The Radical Toolmakers Precise Measuring Microscope is used for the purposes of measuring lengths, angles as well as diameter and distances. As such, it is commonly used by auto component manufacturers, tool manufacturers as well as in quality control or various tools and parts

9) Define the magnification factor of tool maker's microscope?

It is defined as the ratio of the screen diameter to the field diameter in a microscope.

10) What are the advantages of tool maker's microscope?

The Radical Toolmakers Precise Measuring **Microscope** is used for the purposes of measuring lengths, angles as well as diameter and distances. As such, it is commonly used by auto component manufacturers, **tool** manufacturers as well as in quality control or various **tools** and part

MEASUREMENT OF THREAD PARAMETER USING PROFILE PROJECTOR

Viva Questions and Answers

1. **What is interferometer?**
   Interferometer is optical instruments used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.

2. **Name the different types of interferometer?**
   1) NPL flatness interferometer 2) Michelson interferometer
   3) Laser interferometer 4) Zesis gauge block interferometer.

3. **Name the common source of light used for interferometer.**
   a. Mercury 198 b.Cad minus c.Krypton 86 d. Helium e. Hydrogen

4. **What is wavelength?**
   The distance between two crust or two rough is called the wavelength

5. **What is the principle of laser.**
   The photon emitted during stimulated emission has the same energy, phase and frequency as the incident photon. This principle states that the photon comes in contact with another atom or molecule in the higher energy level E2 then it will cause the atom to return to ground state energy level E, by releasing another photon. The sequence of triggered identical photon from stimulated at In is known as stimulated emission. This multiplication of photon through stimulated emission' leads to coherent, powerful, monochromatic, collimated beam of light emission. This light emission is called laser.

6. **List the various parts of an optical comparator**
   The optical comparator consists of the following parts such as (i) Pivoted lever. (ii) Objective lens (iii) Scale (iv) Plunger (v) Table and (vi) Base.

7. **What is meant by alignment test on machine tools?**
   The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool.

8. **Why the laser is used in alignment testing?**
   The alignment tests can be carried out over greater distances and to a greater degree of accuracy using laser equipment. Laser equipment produces real straight line, whereas an alignment telescope provides a, imaginary line that cannot be seen in space.

9. **What are the different types of geometrical tests conducted on machine tools?**
   1. Straightness. , 2. Flatness. ,3. Parallelism, equi-distance and coincidence.

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

MEASUREMENT OF SURFACE ROUGHNESS USING SURFACE ROUGHNESS TESTER

Viva Questions and Answers

1. **Give classification of measuring instruments.**
   1. Angle measuring Instruments.
   2. Length measuring Instruments.
   3. Instruments for surface finish.
   4. Instruments for deviations.

2. What are the factors affecting surface roughness?
   a) Vibrations b) Material of the work piece c) Tool d) Machining type

3. **What are the methods used for evaluating the surface finish?**
   a) Peak to valley height method. b)The average roughness method. c) Form factor method.

4. **Define fullness and emptiness in form factor.**
   Degree of fullness (K)= area of metal /Area of enveloping rectangle Degree of emptiness = 1 - K

5. **What are the methods used for measuring surface roughness?**
   a) Inspection by comparison b) Direct instrument measurements.

6. **What are the stylus probe instruments?**
   a) Profilo meter b) Taylor Hobson Talysurf c) Tomlinson surface meter

7. **Define : lay**
   Lay: -Direction of the 'predominate surface pattern'

8. **Define: Straightness of a line in two planes.**
   A line is said to be straight over a given length, of the variation of the distance of its points from two planes perpendicular to each other and parallel to the direction of a line remaining within the specified tolerance limits.

9. **Define: Roundness. Name the four measurement of roundness.**
   It is a surface of revolution where all the surfaces intersected 'by any plane perpendicular to a common axis in case of, cylinder and cone. a. Heart square circle. b. Minimum radial separation circle. c. Maximum inscribed circle. d. Minimum circumscribed circle.

10. **What is runout?**
    Run out -Total range of reading of a fixed indicate Or with the contact points applied to a Surface rotated, without axial movement, about 3 fixed axis.

MEASUREMENT OF FORCE USING FORCE MEASURING SETUP

Viva Questions and Answers

1. **What is Strain Gauge?**
   A Strain gauge (sometimes referred to as a Strain gage) is a sensor whose resistance varies with applied force; It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured

2. **What is Force?**
   Force can be defined as a push or a pull that changes or tends to change the state of rest or uniform motion of an object or changes the direction or shape of an object.

3. **What are the types of Force Measurements?**
   i. Direct Force Measurements ii. Direct Force Measurements

4. **What is accelerometer?**
   Accelerometer an instrument for measuring the acceleration of a moving or vibrating body.

5. **Define wheat Stone Bridge Circuit?**
   A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component.

6. **Give commonly used pressure sensitive devices?**
   The commonly used pressure sensitive devices are bourdon tubes, bellows and diaphragms.

7. **What are the various types of transducer?**
   A transducer is an electrical device which is used to convert one form of energy into another form. In general, these devices deal with different types of energies such as mechanical, electrical energy, light energy, chemical energy, thermal energy, acoustic energy, electromagnetic energy, and so on.

8. **What is active transducer?**
   Active transducers are those which do not require any power source for their operation. They work on the energy conversion principle. They produce an electrical signal proportional to the input (physical quantity).

9. **What is an example of a transducer?**
   A transducer is an electronic device that converts energy from one form to another. Common examples include microphones, loudspeakers, thermometers, position and pressure sensors, and antenna.

10. **What are the various types of transducer?**
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MEASUREMENT OF STRAIGHTNESS AND FLATNESS USING TWO AXIS AUTO COLLIMATOR

Viva Questions and Answers

1. **What is flatness?**
   It is defined as minimum distance between two planes within which all the points on a surface lie.

2. **Define Straightness.**
   It is the characteristic of a line where all the elements of a line are colinear. In general, there could be two lines, within which, all the points on a line lie.

3. **What is autocollimator?**
   An autocollimator is an optical instrument for non-contact measurement of angles. They are typically used to align components and measure deflections in optical or mechanical systems.

4. **What are the applications of autocollimator?**
   The autocollimator has a wide variety of applications including precision alignment, detection of angular movement, verification of angle standards, and angular monitoring over long periods.

5. **Define the tolerance for Straightness.**
   Straightness actually has two very different functions in GD&T depending how it is called out. In its normal form or Surface Straightness, is a tolerance that controls the form of a line somewhere on the surface or the feature.

6. 6. **What is interferometer?**
   Interferometer is optical instruments used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.

7. **Name the different types of interferometer?**
   1) NPL flatness interferometer 2) Michelson interferometer
   3) Laser interferometer 4) Zesis gauge block interferometer.

8. **Distinguish between geometrical test and practical test on a machine tool**
   The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool. Performance test consist of checking the accuracy of the finished component. Alignment test consist of checking the relationship between various machine elements when the machine tool is idle. Performance test consists of preparing the actual test jobs on the machine and checking the accuracy of the jobs produced.

9. **What are the different types of geometrical tests conducted on machine tools?**
   1. Straightness. , 2. Flatness 3. Parallelism, equi-distance and coincidence.

10. **Define axial length measuring accuracy**
    It is defined as difference between the reference length of gauges aligned with a machine axis and the corresponding measurement results from the machine.

TEMPERATURE MEASUREMENT USING THERMOCOUPLE

Viva Questions and Answers

1. **What is thermocouple?**
   When two metals are joined together it will create an emf and it is primarily a function of the junction temperature.

2. **What are the major advantages of a thermocouple?**
   Advantages of the thermocouple include a wide range from -300°F to 2300°F, fast response time (under a second in some cases), low initial cost and durability. Overall, thermocouples are able to withstand rugged applications.

3. **What are the major disadvantages of a thermocouple?**
   Disadvantages for thermocouples are their wide accuracy range, especially at elevated temperatures, difficult to recalibrate (seeing as though they are dependent upon the environment) and, finally, installation can be expensive if long lengths of thermocouple wire are needed.

4. **What is a thermocouple & how does it work?**
   A thermocouple is a device used extensively for measuring temperature. A thermocouple is comprised of at least two metals joined together to form two junctions. One is connected to the body whose temperature is to be measured; this is the hot or measuring junction. The other junction is connected to a body of known temperature; this is the cold or reference junction. Therefore the thermocouple measures unknown temperature of the body with reference to the known temperature of the other body.

5. **What is the working principle of a thermocouple?**
   The working principle of thermocouple is based on three effects, discovered by Seebeck, Peltier and Thomson. They are as follows: 1) Seebeck effect: The Seebeck effect states that when two different or unlike metals are joined together at two junctions, an electromotive force (emf) is generated at the two junctions. The amount of emf generated is different for different combinations of the metals.

6. **What are the applications of a thermocouple?**
   Thermocouples are widely used in science and industry. Applications include temperature measurement for kilns, gas turbine exhaust, diesel engines, and other industrial processes.

7. **What is the principle involved in fluid expansion thermometer?**
   Change in pressure in the bulb is taken as an indication of the temperature.

8. **What is a Kentometer?**
   It is a device for measurement of absolute pressure.

9. **What is thermopile?**
   When thermocouples are connected in series it is called thermopile

10. **Give the principle of hot wire anemometer.**
    When a fluid flows over a heated surface heat is transferred from the surface and so the temperature reduces. The rate of reduction of temperature is related to flow rate.

MEASUREMENT OF TORQUE USING TORQUE MEASURING SETUP

Viva Questions and Answers

1. **Define transducer?**
   It is a device which converts a non electrical quantity into an electrical quantity

2. **Mention some of the transducers.**
   Variable Resistor, Variable inductor, Variable capacitor, Synchros & Resolvers
3. **What is Torque?**
   Torque is a twisting or turning force about an axis that can be applied in a clockwise or counter-clockwise direction.

4. **What is the most common torque measuring principle?**
   It uses bonded strain gauge technology, where the strain gauges are bonded to a suitably designed shaft.

5. **What is a torque meter?**
   A torque sensor or torque transducer or torque meter is a device for measuring and recording the torque on a rotating system.

6. **How does a torque meter work?**
   It uses strain gauges applied to a rotating shaft or axle. With this method, a means to power the strain gauge bridge is necessary, as well as a means to receive the signal from the rotating shaft. This can be accomplished using slip rings, wireless telemetry, or rotary transformers.

7. **What is a load cell?**
   A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells.

8. **What are the aapplications of torque measurement?**
   Rotary torque sensors are used for strain measurement, testing of clutch and gearboxes, and dynamic torque within the engine. Additionally, power-train, brake, and suspension systems are tested using torque sensors, which are also used to measure horsepower in the interest of improving fuel efficiency.

9. **What is Precision?**
   Precision of an instrument indicates its ability to reproduce a certain reading with a given accuracy. It is the degree of agreement between repeated results.

10. **Define sensitivity.**
    Sensitivity is the ratio of the magnitude of the output quantity (response) to the magnitude Of input quantity. Ex: 1 mV recorder might have a 10 cm scale. Its sensitivity would be a 10 cm/ mV. Assuming that measurement is linear all across the scale.

MEASUREMENT OF DISTANCE USING LVDT

Viva Questions and Answers

1. **What is LVDT?**
   VDT stands for Linear Variable Differential Transformer. An LVDT is also referred to as a linear displacement transducer, or linear position transducer. This sensor device measures linear displacement very accurately.

2. **What are the applications of LVDT?**
   Sometimes referred to as a linear position sensor, the LVDT is found in many critical industrial, military, aerospace, and subsea applications including down-hole drilling, nuclear power, and process control.

3. **State the advantages of LVDT.**
   - The LVDT has low power consumption.
   - It has higher sensitive.
   - It has ruggedness.
   - It has wide range.
   - It has low hysteresis.

4. **State the disadvantages of LVDT?**
   - It has large primary voltage produce distortion in output.
   - Temperature affects the performance.
   - Sensitive to stray magnetic field.

5. **State the applications of LVDT.**
   - It act as a secondary transducer, it is used to measure force, weight and pressure.
   - It can be used for displacement measurement ranging from fraction of mm to few cm.

6. **What is the function of LVDT?**
   LVDT is an acronym for Linear Variable Differential Transformer. It is a common type of electromechanical transducer that can convert the rectilinear motion of an object to which it is coupled mechanically into a corresponding electrical signal.

7. **What is active transducer?**
   Active transducers are those which do not require any power source for their operation. They work on the energy conversion principle. They produce an electrical signal proportional to the input (physical quantity). For example, a thermocouple is an active transducer.

8. **What is an example of a transducer?**
   A transducer is an electronic device that converts energy from one form to another. Common examples include microphones, loudspeakers, thermometers, position and pressure sensors, and antenna.

9. **What are the various types of transducer?**
   A transducer is an electrical device which is used to convert one form of energy into another form. In general, these devices deal with different types of energies such as mechanical, electrical energy, light energy, chemical energy, thermal energy, acoustic energy, electromagnetic energy, and so on.

10. **Give commonly used pressure sensitive devices?**
    The commonly used pressure sensitive devices are bourdon tubes, bellows and diaphragms.

BORE DIAMETER MEASUREMENT USING TELESCOPE GAUGE

Viva Questions and Answers

1. **Define Bore Gauge.**
   A dial bore gauge is a special tool, calibrated in .001 inch (.0025 centimeter) or .0001 inch (0.00025 centimeter), which is used to accurately measure the inside diameter of a hole, cylinder or pipe. In conjunction with a micrometer, a bore gauge will give you the exact reading of a bore size.

2. **Define Tolerance.**
   Engineering tolerance is the permissible limit or limits of variation in: a physical dimension; a measured value or physical property of a material, manufactured object, system, or service; other measured values (such as temperature, humidity, etc.).

3. **Define Fit.**
   A fit may be defined as the degree of tightness and looseness between two mating parts.

4. **What is Calibration?**
   Calibration is the process of configuring an instrument to provide a result for a sample within an acceptable range.

5. **Define Limits.**
   The term limits of size referred to the two extreme permissible sizes for a dimension of a part, between which the actual size should lie. The largest permissible size for a dimension is called upper or high or maximum limit, whereas the smallest size is called lower or minimum limit.

6. **What is the use of telescopic gauge?**
   A telescopic gauge is a measuring tool with spring loaded plunges used together with a micrometer to measure the inside of holes or bores.

7. **How to use the dial bore gauge?**
   A dial bore gauge is a special tool, calibrated in 0.001 inch or 0.0001 inch, which is used to accurately measure the inside diameter of a hole, cylinder or pipe. In conjunction with a micrometer, a bore gauge will give you the exact reading of a bore size.

8. **Define roundness.**
   It is the measure of flow closely the shape of an object approaches that of a mathematically perfect circle.

9. **Define cylindricity.**
   It is fairly common callout for shafts, pins and any critical cylindrical element. When a part needs to be both round and straight along its axis, such as a sliding shaft, or a dynamic locating pin, cylindricity is usually called out.

10. **What is Relative error?**
    Relative error is defined as the results of the absolute error and the, value of comparison used for Calculation of that absolute error. The comparison may be true value or conventional true value or arithmetic mean for series of measurement.