E.G.S. PILLAY ENGINEERING COLLEGE
Nagapattinam – 611002.

DEPARTMENT OF MECHANICAL ENGINEERING

V SEMESTER

REGULATION 2013 CHENNAI

ME 6513- METROLOGY AND MEASUREMENTS LAB

LAB MANUAL

Prepared & Compiled by

J.Jeevamalar, M.E., (Ph.D.),

Laboratory in Charge

Department of Mechanical Engineering

E.G.S. PILLAY ENGINEERING COLLEGE
Nagapattinam – 611002.

DEPARTMENT OF MECHANICAL ENGINEERING

ME 6513- METROLOGY AND MEASUREMENTS LAB

Name : ....

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Year & Sec. : ....

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LIST OF EXPERIMENTS

X. NO.:	INTRODUCTION TO METROLOGY	DATE:

AIM

To study about the basics of the engineering 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. Metrology is mainly concerned with the following aspects

- Unit of measurement and their standards.
- Errors of measurement.
- Changing the units in the form of standards.
- Ensuring the uniformity of measurements.
- New methods of measurement developing.
- Analyzing this new methods and their accuracy.
- Establishing uncertainty of measurement.
- Gauges designing, manufacturing and testing.
- Researching the causes of measuring errors.
- Industrial Inspection.

FUNCTIONS OF METROLOGY

- To ensure conservation of national standards.
- Guarantee their accuracy by comparison with international standards.
- To organise 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.

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. It is summarised as

- To conforming the materials or products to the standard.
- To avoid faulty product coming out.

- To maintain the good relationship between customer and manufacturer.
- To meet the interchangeability of manufacturer.
- To maintain the good quality.
- To take decision on the defective parts.
- To purchase good quality raw materials.
- To reduce the scrap.

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.

METHODS OF MEASUREMENT

1. Direct comparison with Primary or Secondary Standard.
2. Indirect comparison with a standard through calibration system.
3. Comparative method.
4. Coincidence method.
5. Fundamental method.
6. Contact method.
7. Transposition method.
8. Complementary method.
9. Deflection method.

RESULT

Thus the basics of the engineering metrology and measurements were studied

EX. NO.:	MEASUREMENT O F COMPONENTS USING VERNIER CALIPER	DATE:

AIM:

To measure the external diameter of the given specimen using vernier caliper.

APPARATUS REQUIRED:

- Vernier caliper.
- Specimen.

DESCRIPTION:

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.

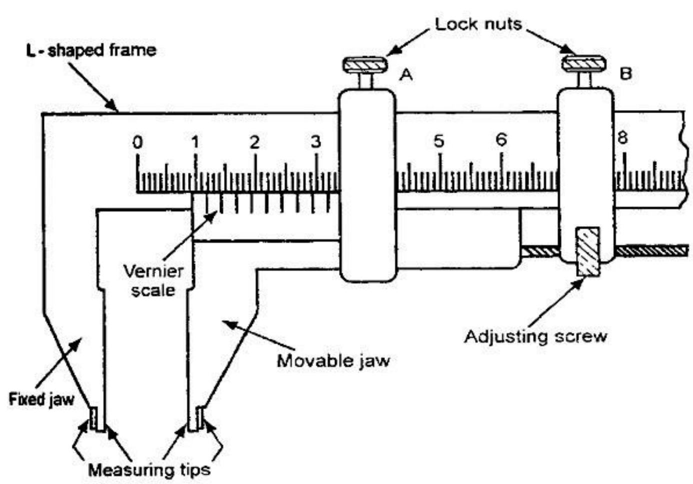
PROCEDURE:

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.

FORMULA:

$$\text{Least count} = \frac{main\ scale\ reading}{no.of\ vernier\ scale\ divisions} = 0.02\text{mm}$$

DIAGRAM:



TABULATION **L.C=0.02mm**

Sl. No.	Specimen's Name & Specification	Main Scale Reading (M.S.R) (mm)	Vernier Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Average Reading (mm)
1					
2					
3					
4					
5					

VIVA QUESTIONS:

1. What is vernier caliper?
2. What is the use of Vernier Scale?
3. What is least count (L.C.)?
4. What are units of vernier scale?
5. What are the types of vernier caliper

RESULT:

Thus the dimension of the given specimen was measured by using vernier caliper.

Specimen I. --------------------------------

Specimen II. ------------------------------

EX. NO.:	MEASUREMENT O F COMPONENTS USING VERNIER HEIGHT GAUGE	DATE:

AIM:

To measure the height of given work piece by using vernier height gauge.

APPARATUS REQUIRED:

- Vernier caliper.
- Flat table.
- Specimen.

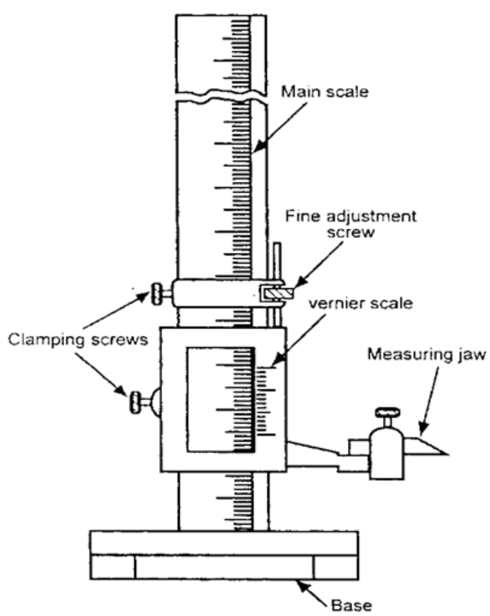
DESCRIPTION:

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.

PROCEDURE:

1. The height gauge is placed on the surface plate is adjusted to zero correction.
2. The specimen is placed on the surface plate is adjusted to height gauge.
3. The sliding jaw is raised and placed on the top surface of the specimen.
4. The reading from main scale and vernier scale are noted.
5. Thus the height of the specimen was calculated and tabulated.

DIAGRAM:



TABULATION: **L.C=0.02mm**

Sl. No.	Specimen's Name & Specification	Main Scale Reading (M.S.R) (mm)	Vernier Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Average Reading (mm)
1					
2					
3					
4					
5					

VIVA QUESTIONS:

1. What is the difference in the measurement of one smaller division on the main scale (M.S.) and that of vernier scale (V.S.)?
2. How the L.C. of a vernier is determined?
3. Will the accuracy of a vernier will increase or decrease if 20 divisions are made in the same length?
4. Which one is smaller M.S. div. or V.S. div.?
5. What are the applications of Vernier Height Gauge?

RESULT:

Thus the dimension of the given specimen was measured by using vernier height gauge.

First step mean value : -----------------------------

Second step mean value : -----------------------------

Third step mean value : -----------------------------

EX. NO.:	MEASUREMENT O F COMPONENTS USING VERNIER DEPTH GAUGE	DATE:

AIM:

To measure the depth of the given specimen using the vernier depth gauge.

APPARATUS REQUIRED:

- Vernier depth gauge.
- Specimen.

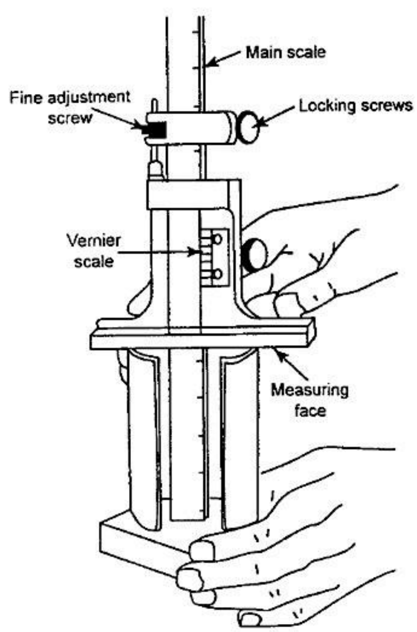
DESCRIPTION:

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 effected when the applied force increases. The least count of vernier depth gauge is 0.02mm.

PROCEDURE:

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.

DIAGRAM:



TABULATION: **L.C=0.02mm**

Sl. No.	Specimen's Name & Specification	Main Scale Reading (M.S.R) (mm)	Vernier Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Average Reading (mm)
1					
2					
3					
4					
5					

VIVA QUESTIONS:

1. What is the least count of digital Vernier caliper?
2. What is the difference between Vernier height gauge, Vernier depth gauge, and Vernier caliper?
3. What is the least count of digital Vernier caliper?
4. Name some linear measuring devices?
5. Write the applications of vernier depth gauge

RESULT:

Thus the dimensions of the given specimen were measured by using vernier depth gauge.

Specimen I : ----------------------------

Specimen II : ----------------------------

EX. NO.:	MEASUREMENT O F COMPONENTS USING MICROMETER	DATE:

AIM:

To obtain the thickness and diameter of the work piece using the micrometer.

APPARATUS REQUIRED:

- Micrometer
- Specimen

DESCRIPTION:

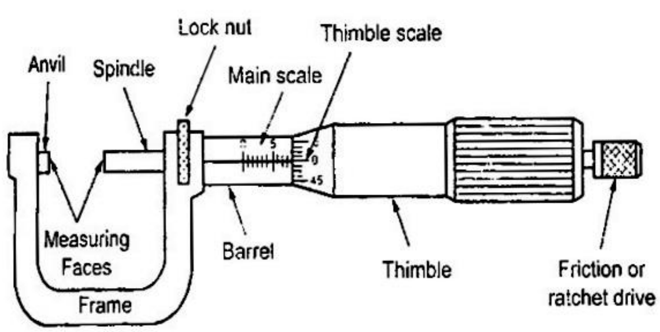
The micrometer is a linear measuring instrument. The micrometer has an accurate screw consisting of 10 to 20 threads per cm. This screw rotates inside a fixed nut. The end of the screw acts as one measuring tip and fixed anvil acts as other measuring tip. Threads are cut for certain length on screw and 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. But the thimble has 25 divisions around the circumference. So each revolution is again divided into25 divisions. Therefore each division is equal to 0.02mm. So its least count is 0.02mm

PROCEDURE:

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:



TABULATION: **L.C=0.02mm**

Sl. No.	Specimen's Name & Specification	Main Scale Reading (M.S.R) (mm)	Vernier Scale Division (V.S.D) (Div)	Correct Reading CR=MSR+(VSD×LC) (mm)	Average Reading (mm)
1					
2					
3					
4					
5					

VIVA QUESTIONS:

1. What is micrometer?
2. Explain zero error and zero correction in case of micrometers?
3. Explain briefly about the different types of micrometers?
4. What is the least count of a micrometer and how is it determined?
5. How to maintain constant pressure in micrometer?

RESULT:

Thus the dimension of the given workpiece was measured using micrometer.

Stainless steel : -----------------------

Mild steel 1 : -----------------------

Mild steel 2 : -----------------------

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

AIM:

To check the dimensions of a given set of specimen using a mechanical comparator.

APPARATUS REQUIRED:

- Mechanical comparator.
- Surface plate.
- Height gauge.
- Specimens.

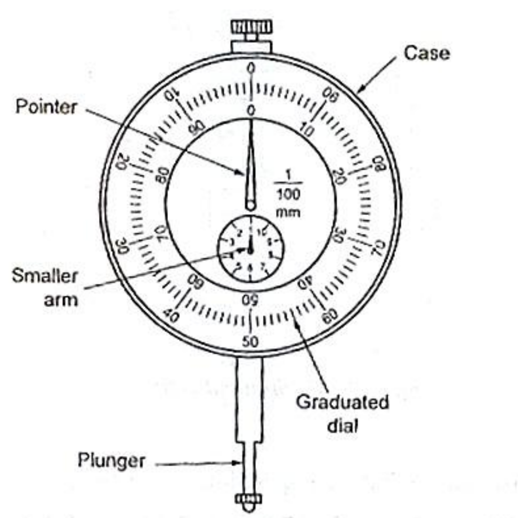
DESCRIPTION:

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.

PROCEDURE:

1. Check the flatness of the surface plate with respect to horizontal using a spirit level.
2. Measure the height of the specimen using a vernier height gauge.
3. Take a standard specimen and get the value in the comparator.
4. Check for the deviation from standard value using the dial gauge.
5. Draw a graph between deviations from the deviation of standard value for number of specimen.

DIAGRAM:



TABULATION:

STANDARD SPECIMEN

HEIGHT :
TOLERANCE :

Sl. No.	Specimen Height (h) (mm)	Deviation (mm)	Sample Acceptable/ Rejectable
1			
2			
3			
4			
5			

VIVA QUESTIONS:

1. What is comparator?
2. What are the types of comparators?
3. What is the LC for comparators?
4. What is the difference between comparator and measuring instruments?
5. What are the advantages of Comparator?

RESULT:

Thus the dimensions of the given set of specimens are checked using mechanical comparator and the graph was drawn with number of specimen vs. deviation.

EX. NO.:	MEASUREMENT OF GEAR PARAMETERS USING GEAR TOOTH VERNIER	DATE:

AIM:

To measure the thickness and depth of the gear using gear tooth vernier.

APPARATUS REQUIRED:

- Gear tooth vernier.
- Gear blank.

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.

FORMULA:

$$\textit{Depth } d = \frac{Nm}{2}\left[1 + \frac{2}{n} - \cos\frac{90}{n}\right]$$

Where,

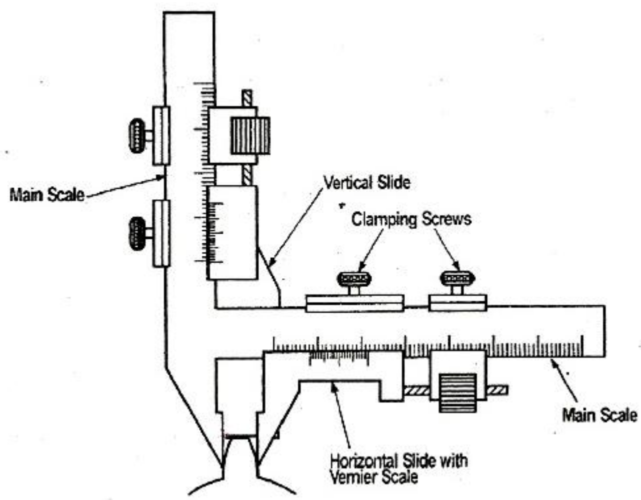
N = Number of teeth, m = Module of gear.

$m = \frac{blank\ dia}{N+2}$ mm **Thickness** $t = \frac{\pi \times m}{2}$ mm

PROCEDURE:

- First the number of teeth in gear blank was counted and diameter was measured.
- Calculate the module of pitch circle diameter of gear.
- By the above formulas the depth and thickness of the given gear was calculated.
- Calculate the tooth thickness by normal measuring.
- Compare the theoretical value with practical value and the error is noted as the difference.
- Thus the same procedure for the remaining tooth.

DIAGRAM:



TABULATION **L.C=0.02mm**

(i). CALCULATING THICKNESS:

Gear Tooth Number	Actual Reading (mm)	Measured Reading Thickness			Error (mm)
		MSR (mm)	VSD (mm)	Correct reading (mm)	
1					
2					
3					
4					
5					
				Avg. Error:	

(ii). CALCULATING DEPTH:

Gear Tooth Number	Actual Reading (mm)	Measured Depth			Error (mm)
		MSR (mm)	VSD (mm)	Correct reading (mm)	
1					
2					
3					
4					
5					
				Avg. Error:	

VIVA QUESTIONS:

1. What are the applications of Gear tooth vernier caliper?
2. How do we check the profile of a Gear tooth?
3. What are the methods available for measuring gear profile?
4. What is Pitch?
5. Define Module?

RESULT:

Thus the thickness and depth of the gear tooth was calculated and the error found out.

EX. NO.:	MEASUREMENT OF THREAD PARAMETER USING PROFILE PROJECTOR	DATE:

AIM:

To measure the thread parameter using the profile projector.

APPARATUS REQUIRED:

- Profile projector.
- Specimen.

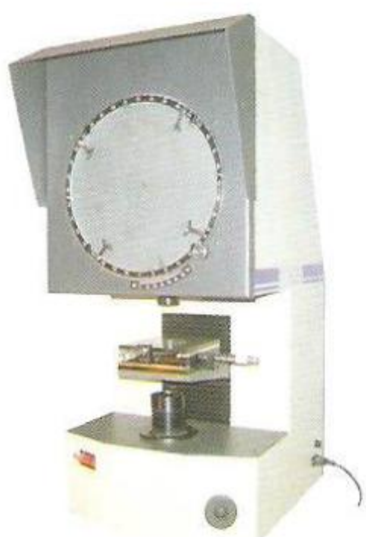
DESCRIPTION:

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: **L.C=0.01mm**

Position	MSR (mm)	TSR (mm)	CR = MSR+ (TSR×LC)	Initial - Final Reading
Initial				
Final				

(ii) Minor diameter:

Position	MSR (mm)	TSR (mm)	CR = MSR+ (TSR×LC)	Initial - Final Reading
Initial				
Final				

(iii) Angle:

Position	MSR (mm)	TSR (mm)	CR = MSR+ (TSR×LC)	Initial - Final Reading
Initial				
Final				

(iv) Pitch:

Position	MSR (mm)	TSR (mm)	CR = MSR+ (TSR×LC)	Initial - Final Reading
Initial				
Final				

(v) Height:

Position	MSR (mm)	TSR (mm)	CR = MSR+ (TSR×LC)	Initial - Final Reading
Initial				
Final				

VIVA QUESTIONS:

1. What are the types of gear profile checking method?
2. What is floating carriage micrometer?
3. What is effective diameter of thread?
4. What is minor diameter of thread?
5. What is Best Wire Method?

RESULT:

Thus the Major, Minor, Pitch Angle of the given screw threads were measured by using profile projector.

EX. NO.:	MEASUREMENT OF ANGLE USING VERNIER BEVEL PROTRACTOR	DATE:

AIM:

To measure the angle of the specimen using the universal bevel protractor.

APPARATUS REQUIRED:

- Universal bevel protractor.
- Specimen.

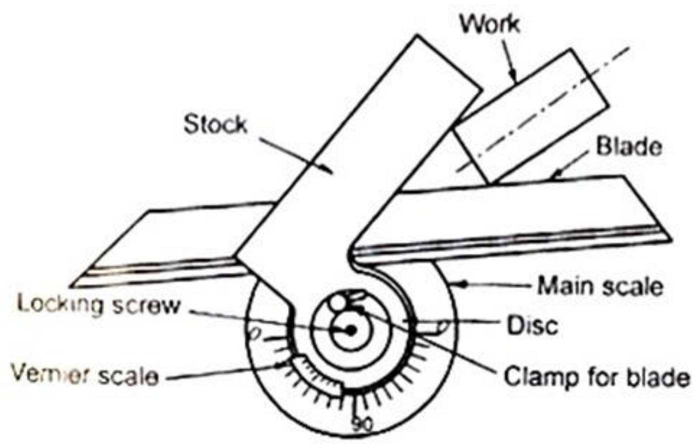
DESCRIPTION:

Universal bevel protractor is an angular measuring instrument used to measure the angle of a specimen accurately. There is a blade in the bevel protractor used to place the specimen under it. There is an angular graduated main scale used to note out the angle of a specimen accurately. The least count of the universal bevel protractor is 0.001°.

PROCEDURE:

1. Place the specimen between the base plate and the blades.
2. The blade should touch the slope of the specimen.
3. The coincidence of main scale readings and vernier scale readings are noted.
4. Then the angle will be calculated.

DIAGRAM:



TABULATION:

Sl. No.	MSR (Degree)	VSR (Min.)	Correct Reading
1			
2			
3			
4			
5			

VIVA QUESTIONS:

1. What is the use of angle plates?
2. Name some angle measuring devices?
3. What is the least count of mechanical Bevel Protractor?
4. What are the types of Bevel Protractor?
5. Differentiate between Sine bar and Protractor?

RESULT:

Thus the angle of the given specimen was found by using universal bevel protractor.

Angle of Rod : -----------------------

Angle of Bolt : -----------------------

EX. NO.:	MEASUREMENT OF TAPER ANGLE MEASUREMENT USING SINE BAR AND SLIP GAUGE	DATE:

AIM:

To measure the angle of taper surface using the sine bar.

APPARATUS REQUIRED:

- Surface plate.
- Sine bar.
- Slip gauge.

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:

$$Sin\ \theta = \frac{h}{l}$$

Where,

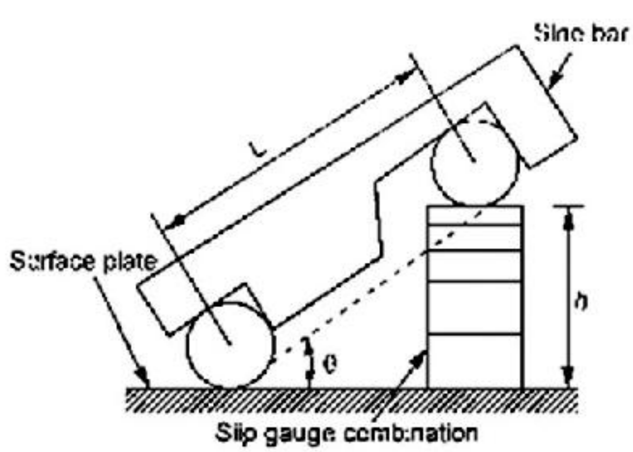
θ = Angle of taper surface in Degrees, h = Height of slip gauge in mm.

l Length between the rollers in mm = 200mm

PROCEDURE:

1. The component of parallel on the surface plate for a steady support, the sine bar is placed on the top surface in taper.
2. The slip gauge are added and assured to clear the gaps.
3. Then the height of the slip gauges is measured.
4. Then the angle of taper was found by the above formula.

DIAGRAM:



TABULATION:

Sl. No.	Specimen's Name and Specification	Height of Slip Gauge (h_1) (mm)	Height of Slip Gauge on other side (h_2) (mm)	Angle (θ) (Deg)
1				
2				
3				
4				
5				

VIVA QUESTIONS:

1. What is a sine bar?
2. What are the limitations of Sine bar?
3. What are slip gauges and why do we use them?
4. What is the difference between the sine bar and sine center?
5. What are the modifications of Sine bar?

RESULT:

The taper angle of the given specimen is

a. Using bevel protractor =_________________________ degrees

b. Using sine bar =_________________________ degrees

EX. NO.:	MEASUREMENT OF THREAD PARAMETERS BY USING FLOATING CARRIAGE MICROMETER	DATE:

AIM:

To measure the major, minor and effective diameter of given specimen by using a floating carriage micrometer.

APPARATUS REQUIRED:

- Floating carriage micrometer.
- Specimen.

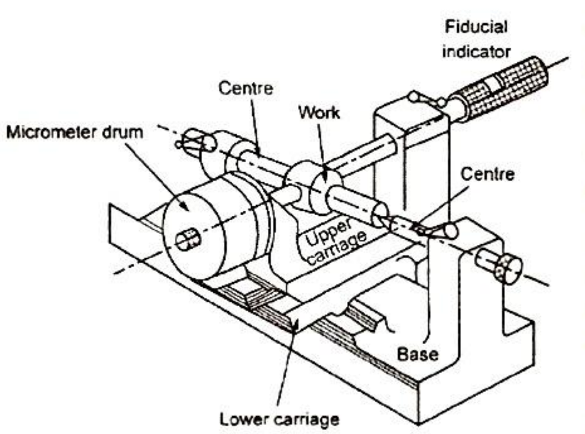
DESCRIPTION:

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 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:

Major diameter

$max = D + (Rs - Rw)$, $min = D - (Rs - Rw)$

Minor diameter

$max = D + (Rs - Rw)$, $min = D - (Rs - Rw)$

Effective diameter

$max = D + (Rs - P) - Rw$, $min = D - (Rs - p) - Rw$

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					

VIVA QUESTIONS:

1. What is floating carriage micrometer?
2. What is effective diameter of thread?
3. What is minor diameter of thread?
4. Define pitch.
5. Define Flank Angle?

RESULT:

Thus the diameter of specimen was measured by using floating carriage micrometer.

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

EX. NO.:	**MEASUREMENT OF TORQUE USING GAUGE LOAD CELL**	**DATE:**

AIM:

To measure the torque using Strain Gauge Load Cell.

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 = DX,

D = Moment of inertia of body about the axis.

X = Angular acceleration.

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.

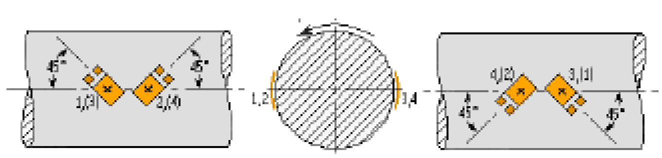
PROCEDURE:

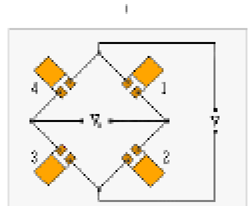
1. Fix the main frame of transducers rigidity.
2. Connect the cantilever beam with weight pan.
3. Connect transducer wire socket to rear side of indicator.
4. Connect digital indicator at 230V, AC supply.
5. Set zero on indicator, by zero adjust pan provides indicator.
6. Now apply the load gradually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

FORMULA USED:

Calculated Torque = Load x Distance (kg-m)

DIAGRAM:





CALCULATION
(i). Distance: 1 meter

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

(ii). Distance: 0.5 meter

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

VIVA QUESTIONS:
1. Define Torque?
2. What is load cell?
3. What are gauges?
4. What is Transducer?
5. What are the types of load cells?

RESULT:
Thus measurement of torque using Strain Gauge Load Cell has been carried out.

EX. NO.:	MEASUREMENT OF FORCE USING STRAIN GAUGE LOAD CELL	DATE:

AIM:

To measure the force using Strain Gauge Load Cell.

APPARATUS REQUIRED:

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

Capacity of proving Ring =2.5 KN.

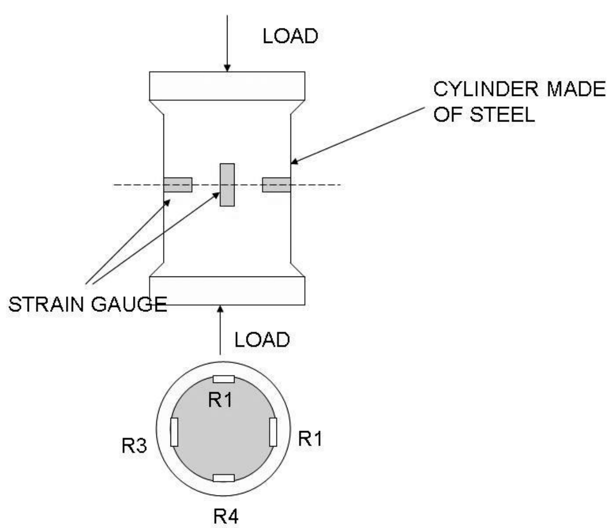
DESCRIPTION:

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 load applied (kg)	Deflection (div)
1		
2		
3		
4		
5		

1 division = 0.002mm

VIVA QUESTIONS:

1. What is Strain Gauge?
2. What is Force?
3. What are the types of Force Measurements?
4. What is accelerometer?
5. Define wheat Stone Bridge Circuit?

RESULT:

Thus the force measurement has been measured using Strain Gauge Load Cell.

EX. NO.:	TEMPERATURE MEASUREMENT USING THERMOCOUPLE	DATE:

AIM:

To measure the temperature using copper constantan Thermocouple.

APPARATUS REQUIRED:

1. Thermo Couple
2. Temperature Measuring Setup.
3. Ice Cubes.

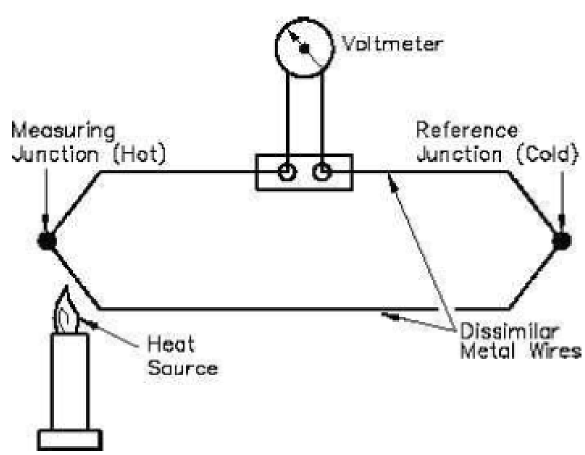
DESCRIPTON:

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		

VIVA QUESTIONS:

1. What is Thermocouple?
2. Distinguish between Thermocouple and Thermometer?
3. What are the advantages of Thermocouple?
4. What is Thermopile?
5. What is Thermister?

RESULT:

Thus the temperature is measured using thermocouple.

EX. NO.:	MEASUREMENT OF STRAIGHTNESS AND FLATNESS USING TWO AXIS AUTO COLLIMATOR	DATE:

AIM:

To measure the straightness and Flatness given specimen using two axis Auto Collimator.

APPARATUS REQUIRED:

Collimator unit, Base, plain reflector, 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:

CALCULATION:

(i). PARALLEL 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					

(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					

VIVA QUESTIONS:

1. Define Straightness.
2. Define the tolerance for Straightness.
3. What is flatness?
4. What is autocollimator?
5. What are the applications of autocollimator?

RESULT:

Thus the straightness and Flatness are determined using autocollimator.