SCHEME : K

Name : _____

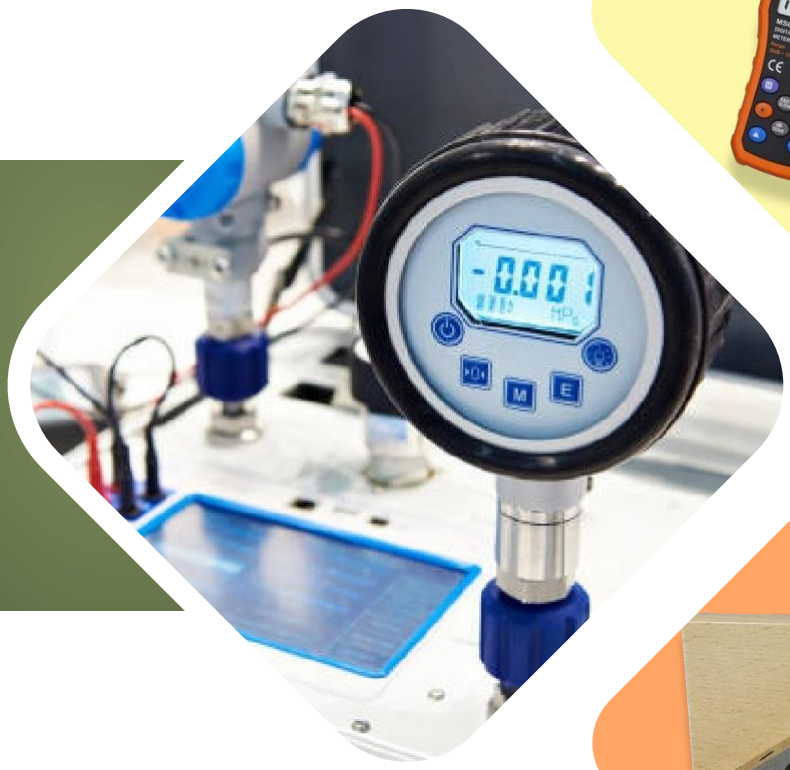
Roll No. : _____ Year : 20___ 20___

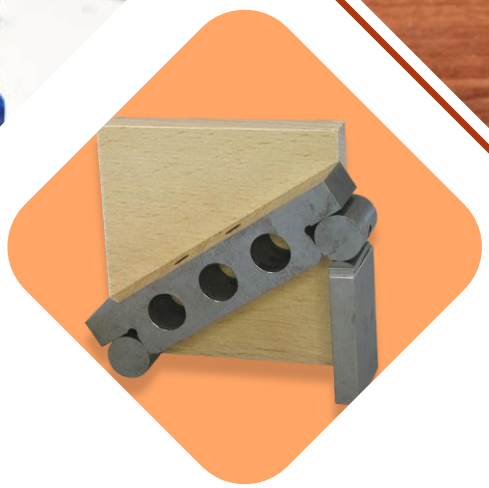
Exam Seat No. : _____

LABORATORY MANUAL FOR

METROLOGY AND MEASUREMENT

(313316)





MECHANICAL ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

VISION:

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION:

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY:

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES:

MSBTE believes in the following:

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education

A Practical Manual

For

METROLOGY AND MEASUREMENT

(313316)

Semester– (III/IV)

"K-SCHEME"

(Diploma in Mechanical/Production Engineering)
(ME/PG)

Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO-9001-2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education, Mumbai
(Autonomous) (ISO-9001-2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai -400051,
(Printed On July, 2024)

Maharashtra State
Board of Technical Education, Mumbai

Certificate

This is to certify that Mr. / Ms. …… Roll No……. of Third/Fourth Semester of Diploma in …… of Institute ……
(Code……..) has completed the term work satisfactorily in course Metrology and Measurement (**313316)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place: …… Enrollment No……
Date: ..... Exam Seat No. ……..

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much-needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programmes with National Education Policy2020 (NEP2020) and outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'K' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes***, rather than the traditional age-old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

Measurement activities are given prime importance in industry. The diploma technicians often come across measuring different parameters of machined components and the appropriate fitment of interchangeable components in the assemblies. Student has to be decide the accuracy required, select the instrument, and investigate reasons for defects and give suggestions, decide whether to accept or reject the methods and instruments which can be used for linear and angular measurements, geometrical parameters (like surface finish, squareness, parallelism, roundness etc.) and the use of gauges and system of limits, fits, tolerances etc. are often required to be dealt in detail by a diploma engineer on the shop floor. Also the student has to identify and use different types of transducers and sensors to measure parameters like force, torque, strain and displacement. They should know how to measure process parameters like flow, temperature, pressure, speed and humidity. To control, monitor and analyze the process. Therefore, this course attempts to impart the necessary knowledge and develop the required abilities so that he can perform his job efficiently and effectively in modern industry.

The Practical manual development team wishes to thank MSBTE who took initiative in the development of curriculum and implementation and also acknowledge the contribution of individual

course experts who have been involved in laboratory manual as well as curriculum development (K scheme) directly or indirectly.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

Lab Manual Development Team

Programme Outcomes (POs) to be achieved through Practical of this Course

Following POs are expected to be achieved through the practical of the (Metrology and Measurement) course

PO1. Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the mechanical engineering problems.

PO2. Problem analysis: Identify and analyze well-defined mechanical engineering problems using codified standard methods.

PO3. Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs in mechanical engineering.

PO4. Engineering Tools, Experimentation and Testing: Apply modern mechanical engineering tools and appropriate technique to conduct standard tests and measurements.

PO5. Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO6. Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities in diverse and multidisciplinary fields.

PO7. Life-long learning: Ability to analyze individual needs and engage in updating in the context of technological changes in mechanical engineering.

List of Industry Relevant Skills-

The following industry relevant skills or the competency is to be developed in you by undertaking the practicals of this laboratory manual.

1. Select and Use relevant measuring instruments for measuring various parameters of machine components.
2. Measure the roundness of given job.
3. Measure the angular deviation.
4. Measure the various elements of screw thread and gear tooth.
5. Measure the surface roughness.
6. Measure linear displacement for given application.
7. Measure temperature of a given system.
8. Measure flow rate of liquid.
9. Measure given weights.
10. Measure sound level of system.
11. Measure speed of rotating shaft.

Practical- Course Outcome Matrix

Course Outcomes (COs)

- CO1-Select and use the relevant instruments for measurement.
- CO2-Use different gauges and comparators for measurement of given components
- CO3-Use relevant instruments for measurement of different parameters of engineering Components.
- CO4- Select relevant instrument for measuring the physical parameters of given system
- CO5- Use relevant instrument for measuring operating parameters of given system.

Sr. No.	Laboratory Practical Titles	CO1	CO2	CO3	CO4	CO5
1	*Measurement of length and weight by using ancient measurement system (IKS)	√	-	-	-	√
2	*Measurement of dimensions of component using vernier caliper, vernier height gauge, vernier depth gauge, micrometer and inside micrometer.	√	-	-	-	-
3	Roundness checking of given component using dial indicator / dial gauge.	-	√	-	-	-
4	*Measurement of unknown angle of a component using Sine bar and verify by using Bevel protractor	-	-	√	-	-
5	*Measurement of the screw thread elements by using floating carriage micrometer and verification by optical profile projector.	-	-	√	-	-
6	*Measurement of the gear tooth elements by using gear tooth vernier caliper and verification by optical profile projector.	-	-	√	-	-
7	*Measurement of the surface roughness of machined surface by using surface roughness tester.	-	-	√	-	-
8	Measurement of flatness of given component by using optical flats.	-	-	√	-	-
9	Measurement of the unknown angle of a given component by Autocollimator / Angle Dekkor.	-	-	√	-	-
10	Measurement of displacement by using Linear Variable Displacement Transducer (LVDT).	-	-	-	√	-
11	Measurement of temperature by thermocouple and Verification by thermometer.	-	-	-	√	-
12	Measurement of flow rate of liquid by rotameter.	-	-	-	√	-
13	Measurement of weight by using a load cell.	-	-	-	-	√
14	Sound intensity measurement using Sound meter.	-	-	-	-	√
15	Measurement of speed of rotating shaft by stroboscope or inductive pick up.	-	-	-	-	√

Guidelines to Teachers

1. ***Teacher need to ensure that a dated log book*** for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practical.
3. For difficult practical if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teacher can maintain various practical related question banks for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines.

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, IS codes, Safety norms, Technical Manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practical.

Content Page

List of Practicals and Progressive Assessment Sheet

Sr. No	Laboratory Practical Titles	Page No.	Date of performance	Date of submission	FA PR marks (25)	Dated sign. of teacher	Remarks (if any)
13	Measurement of weight by using a load cell.	73					
14	Sound intensity measurement using Sound meter.	78					
15	Measurement of speed of rotating shaft by stroboscope or inductive pick up.	82					
Total							

Note: To be transferred to Proforma of CIAAN-2023.

A suggestive list of LLOs is given in the above table. More such LLOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

Practical No: 1 *Measurement of Length and weight by using ancient measurement system (IKS)

I. Practical Significance

The Bhartiya approach is tenacious and aims to promote everyone's well-being. It is critical that we recover the extensive knowledge base of our ancestry and teach the rest of the world the "Indian way" of doing things. To do this, generations of scholars must be trained to illustrate and represent to the rest of the world a way of life that is so distinctive from the rest of our great civilization.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

CO -1. Select relevant linear measuring instrument for measurement.

CO -2. Use relevant instrument for measurement of operating parameters of system.

III. Course Level Learning Outcome (CO)

- Select relevant linear measuring instrument for measurement.
- Use relevant instrument for measurement of operating parameters of system.

IV. Laboratory Learning Outcome(s)-

- Use ancient measurement system for measurement of length and weight.

V. Relative Affective Domain related Outcome(s)-

- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Minimum Theoretical Background with diagram (if required)

The Indus Valley Civilisation was responsible for developing standard weights and measurements. The Indus merchants benefited commercially from the centralized weight and measure system since heavier things, like food grains, were purchased with bigger weights and luxury goods were measured with lower weights. There were weights in categories and multiples of a standard weight. Gauging devices can now be utilized for both linear and angular measurements with effectiveness because to technical standardization. Component manufacture was planned using uniform units of length.

VII. Experimental setup –Nil

1. Measurement of Length

In 1930-31 seasons at Mohenjo-Daro, Ernest Mackay discovered a broken piece of shell bearing 8 divisions of 6.7056mm (0.264 inches) each, with a dot and circles five graduations apart. It may be noted that the interval of the 5 divisions works out to 33.528mm (1.32 inches). This measure is widely known as the Indus Inch.

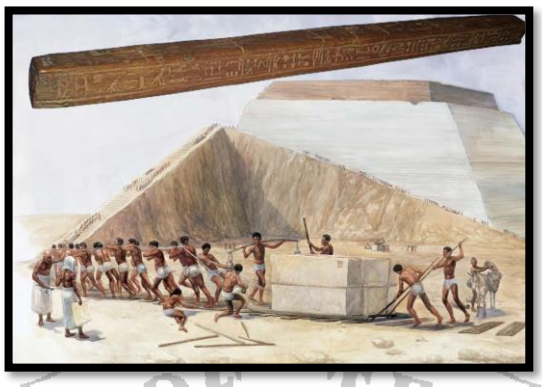


Figure-1.1

In the Artha shastra, Chanakya mentions two types of Dhanush as units for measuring lengths and distances. One is the ordinary Dhanusha, consisting of 96 Angulas, and the other Dhanusha is mentioned as Garhaspatya Dhanusha and consists of 108 Angulas, used for measurement of roads and distances. Chanakya also mentions that a Yojana consists of 8000 Dhanush.

An Indus Inch i.e. 5 divisions of the Mohenjo-Daro scale = 2 Angula,

1 Angula = 16.764mm.

A Dhanusha of 96 Angulas = 96 × 16.764mm = 1.609344 m

A Dhanusha of 108 Angulas = 108 × 16.764mm = 1.810512 m

A Yojana = 8000 Dhanushas = 8000 × 1.810512m = 14.484096 km

Sr No	Old Indian Unit for measurement of Length	Value in terms of 'meter'
1	**Angul**	
2	**Vistati**	
3	**Hasta**	
4	**Dhanush**	
5	**Crosa**	

2. Measurement of Weight

During the pre-Akbar period, weights system varied from region to region, commodity to commodity, and rural to urban areas. The weights were based on the weight of various seeds. The weight was made of iron or of stone. Balance (tula) with two pans of different sizes were used for weighing different quantities. The early unit was a grain of wheat or barleycorn used to weigh the precious metals silver and gold. Larger units preserved in stone standards were developed that was used as units of mass. Akbar standardized weights using barley corn (Jau).

Figure-1.2

The following nomenclature was prevalent in North India before 1833 till the metric system came in: -

4 chawal (grain of rice) = 1 dhan (weight of one wheat berry) 4 dhan = 1 ratti = 1.75 grains = 0.11339825 gram

8 ratti = 1 masha = 0.9071856 gram

12 masha = 96 ratti = 1 tola =180 grains = 11.66375 gram

80 tolas = 1 seer = 870.89816 gram

Sr No	Old Indian Unit for measurement of weight	Value in terms of 'kg'
1	Dhan	
2	Ratti	
3	Tola	
4	Ounce	

VIII. Calculations

IX. Results

X. Interpretation of Results

XI. Conclusions and Recommendation

XII. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Write information of linear measurement system used in ancient India with suitable example.
2. Name different measuring instruments were used in ancient India.

[Space for Answer]

I. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=aom7I0W1gxk

II. Rubrics for Assessment Scheme

	Performance Indicators	Weightage
	Process Related (15 Marks)	**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
	Product Related (10 Marks)	**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No:02 *Measurement of dimensions of component using vernier caliper, vernier height gauge, vernier depth gauge, micrometer and inside micrometer.

I. Practical Significance

Measurement of various dimensions of a component with utmost accuracy and precision is a prime requirement for industry. Such kind of measurement is possible using measuring instruments like Vernier Caliper, Micrometer, and Vernier Height gauge

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Select and Use relevant measuring instruments for measuring various linear parameters of machine components.

III. Course Level Learning Outcome (CO)

CO1 - Select relevant linear measuring instrument for measurement.

IV. Laboratory Learning Outcome(s)

- Measure dimensional parameters by using linear measuring instruments.
- Operate different linear measuring instruments.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment
- Follow ethical Practices

VI. Minimum Theoretical Background with diagram

Vernier caliper, vernier height gauge and Micrometer are the precise instruments used for the linear measurements. The principle of vernier caliper is that when two scales or divisions slightly different in size are used, the difference between them can be utilized to enhance the accuracy of measurement. The Vernier Caliper essentially consists of two steel rules and these can slide along each other

Vernier height gauge is also a sort of a vernier caliper equipped with a special base back and other attachments which make the instrument suitable for height measurement. Along with the sliding jaw assembly arrangement is provided to carry a removable clamp. The upper and the lower surface of the measuring jaw are parallel to the base so that it can be used for measurement over or under the surface. The vernier height gauge is merely used to scribe lines of certain distance above surface. The micrometer essentially consists of U shaped frame. The component to be measured is held between fixed anvil and movable spindle. The spindle can be moved with the help of thimble. There are two scales on micrometer, a main scale and a circular scale. The

barrel is graduated in unit of 0.5 mm whereas thimble has got 50 divisions around its periphery. One revolution of thimble moves 0.5 mm which is the lead of the screw and also the pitch.

VII. Experimental setup

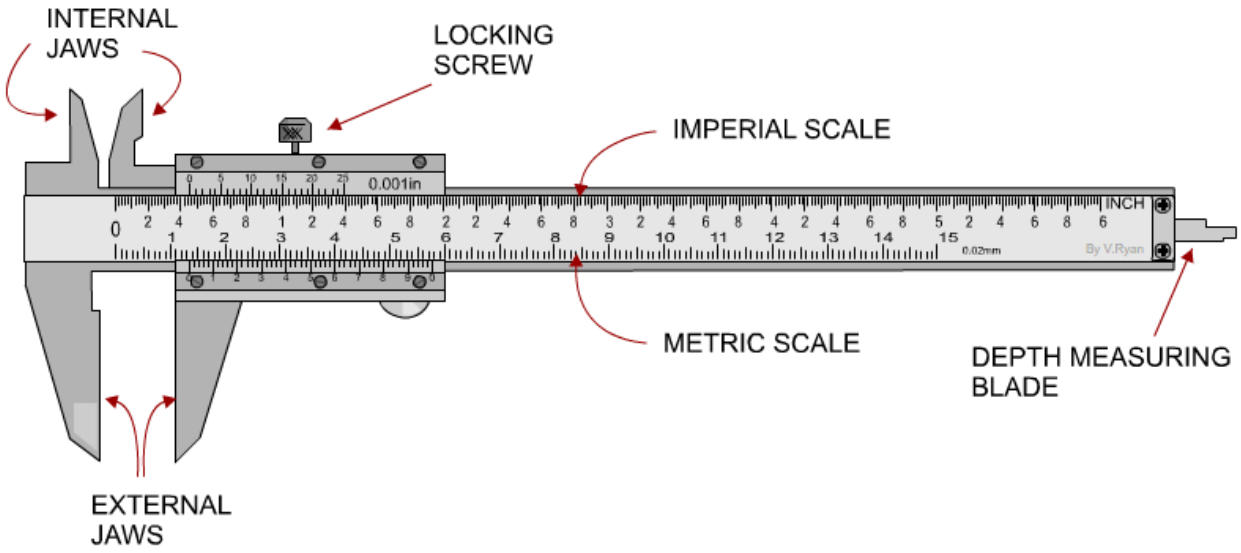


Figure-2.1 Vernier Caliper Details

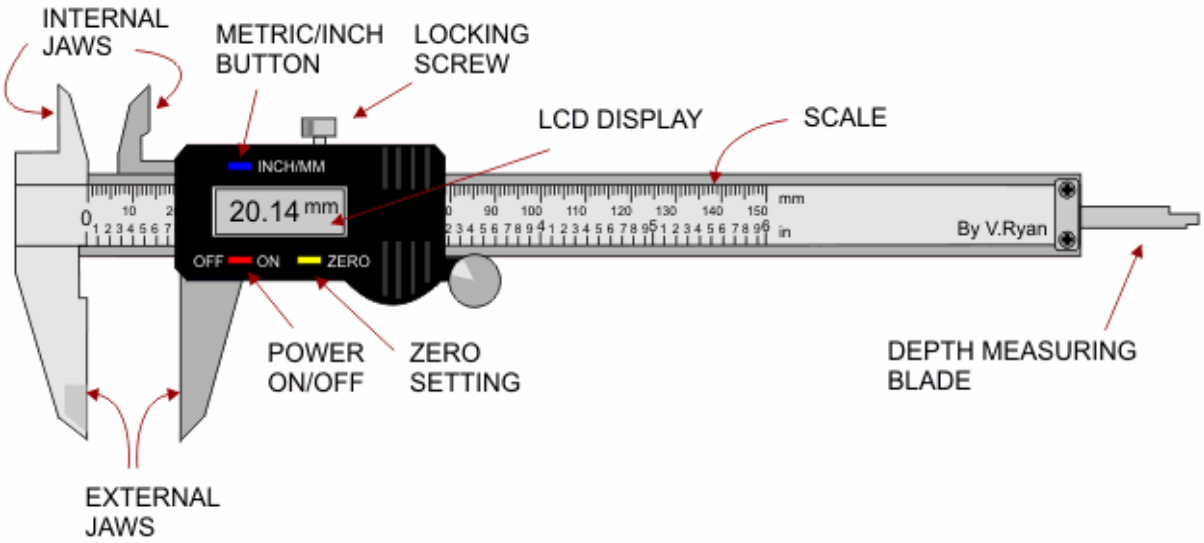


Figure-2.2 Digital Vernier Caliper

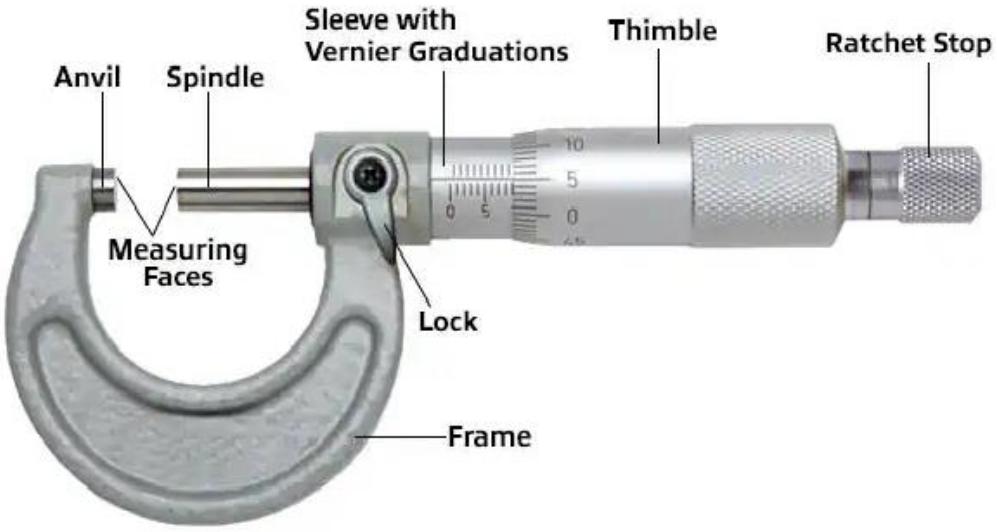


Figure-2.3 Outside Micrometer

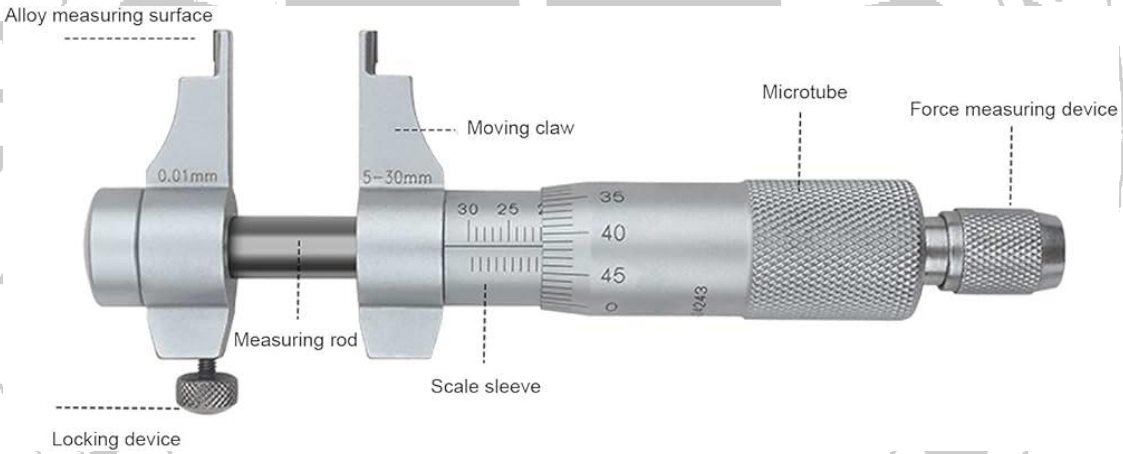


Figure-2.4 Inside Micrometer

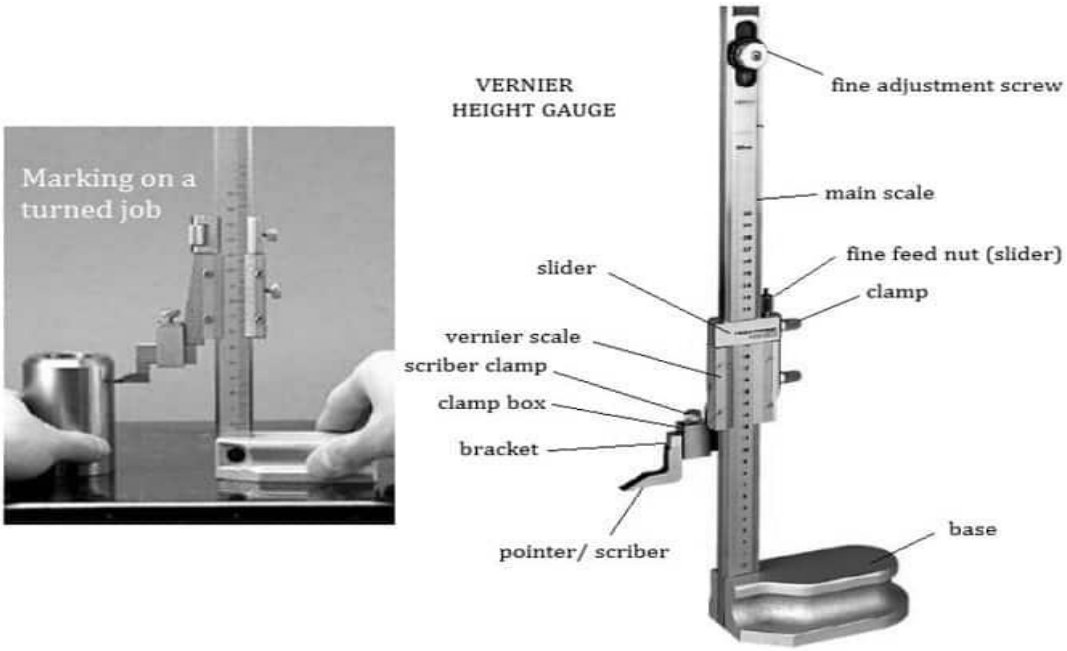


Figure-2.5 Vernier Height Gauge

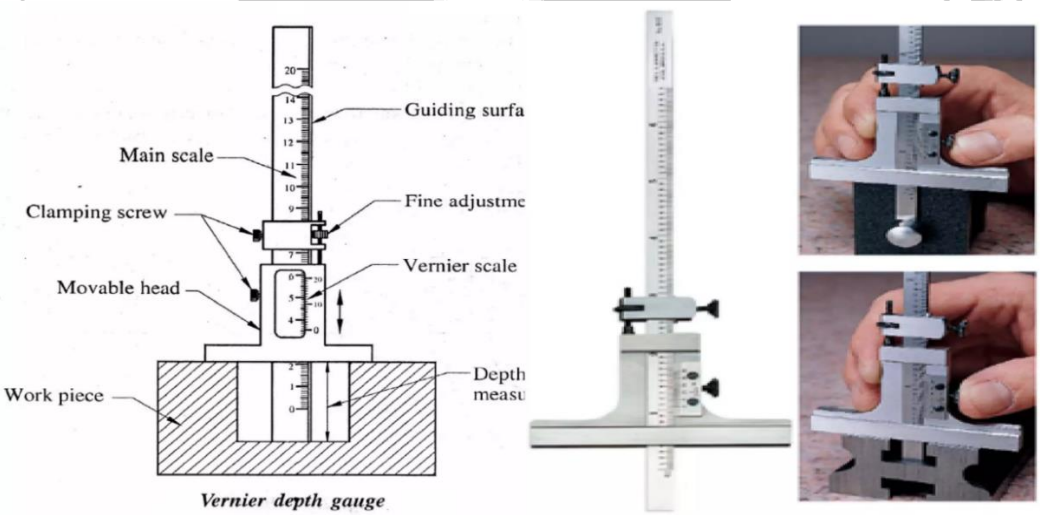


Figure-2.6 Vernier Depth Gauge

VIII. Required Resources /Apparatus/ Equipment with specification

SR. No.	Name of Resource	Suggested Board Specification	Quantity
1	Vernier Caliper	0-200 mm (Manual)	1
2	Digital Vernier Caliper	0-200 mm	1
3	Dial Micrometer	(0-25 mm), (25-50 mm)	1
4	Inside Micrometer	0-200 mm (Manual)	1
5	Surface plate	Granite (200 x 200 x 50)	1

IX. Precautions to be Followed

- Avoid improper handling of instrument
- Don't apply excessive pressure on measuring jaws and anvils.

X. Procedure

1. Clean the work piece and instrument
2. Check the vernier caliper and micrometer for errors like play in the measuring jaws
3. If any error, correct it
4. Calculate the least count of the instrument
5. Hold the work piece in the jaws / anvils
6. Note down the reading on main scale and vernier scale
7. Take the reading for 3 component by Vernier caliper / Digital Vernier caliper / Dial Micrometer / Inside Micrometer
8. Calculate the readings

XI. Observations and Calculations

a. Measurement using Vernier Caliper

Name of work piece	Reading on main scale (MSR) (mm)	Reading on vernier scale (VSR)	Final reading MSR + (LC * VSR) (mm)

b. Measurement using Digital Vernier Caliper

Name of work piece	Reading on main scale (MSR) (mm)	Reading on vernier scale (VSR)	Final reading MSR + (LC * VSR) (mm)

Name of work piece	Reading on main scale (MSR) (mm)	Reading on vernier scale (VSR)	Final reading MSR + (LC * VSR) (mm)

c. Measurement using Micrometer

Name of work piece	Reading on main scale (MSR) (mm)	Reading on vernier scale (VSR)	Final reading MSR + (LC * VSR) (mm)

d. Measurement using Inside Micrometer

Name of work piece	Reading on main scale (MSR) (mm)	Reading on vernier scale (VSR)	Final reading MSR + (LC * VSR) (mm)

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Choose precise instrument used in the experiment
2. Name the instrument used to measure both external and internal dimension
3. State the difference between outside micrometer and inside micrometer

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=sLZeR7RMGFA
- https://www.youtube.com/watch?v=jjw-PGOcflU
- https://www.youtube.com/watch?v=imEqHCW5--o
- https://www.youtube.com/watch?v=i_jygJkJujE
- https://www.youtube.com/watch?v=cXU_cflXlk
- https://www.youtube.com/watch?v=K9LrL-jj2Sg

XVII. Rubrics for Assessment Scheme

	Performance Indicators	Weightage
	Process Related (15 Marks)	**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
	Product Related (10 Marks)	**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 03 Measure Roundness of the given component using dial indicator.

I. Practical Significance

A dial indicator mounted on a magnetic base is being used to measure shaft runout as the shaft is being turned slowly. The runout measurement is reported in terms of the total movement of the indicator needle. Runout measurements in actual operating conditions may be impractical to measure and are likely to be far greater than measurements taken while rotating the shaft slowly, without actual operational loads.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/Employer

- Use different types of comparators.

III. Course Level Learning Outcome (CO)

- CO2-Use the relevant comparator.

IV. Laboratory Learning Outcome(s)

- Check the geometrical parameters of a component with the help of mechanical comparator
- Operate dial gauge for different application

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

Roundness is generally assessed by rotational technique by measuring radial deviations from a datum axis. The polar profile graph can be drawn on a graph paper. To measure out of roundness, it is necessary to compare the part profile to an ideal circle or datum. The most used devices for measurement of roundness are.

a. Diametral Gauge
b. Circumferential confining gauge—a shaft is confined in a ring gauge and rotated against a set indicator probe.
c. Rotating on centers.
d. V-Block. Piece rotating against a set probe (a) of fixed angle, (b) of adjustable angle.
e. Three-point probe (120° spacing).
f. Accurate spindle

The comparator is a device which takes a dimension of standard job as reference dimension, and gives a reading to a pointer on a scale, the variation in such dimension of the job to be compared. Upper end of the vertical beam, an adjusting screw is provided for final zero setting of the scale. A new patented feature is shown at K. This is a magnetic counter balance which serves to neutralism the positive 'rate' of spring reaching on the measuring tip.

In this way a constant pressure over the whole scale range is achieved. The instrument is available with vertical capacities of 6', 12', and 24,' and magnification of 500, 1000, 500, 3000 and 5000. The scales are graduated both in English and Metric systems. The least count is of order of 10R Inch. A work table on the base of this comparator stand is used to keep the job on. Special attachments are used for typical jobs like screw thread effective/outside diameter.

Dial indicator type of mechanical comparator consists of a sensitive dial indicator mounted on a horizontal arm on a stand. The arm is capable of coarse and fine adjustment movements in the vertical direction for initial setting of the Instrument. The base is heavy so that stability and rigidity of the instrument is ensured. Different attachments are available depending upon the type or job

VII. Experimental Setup

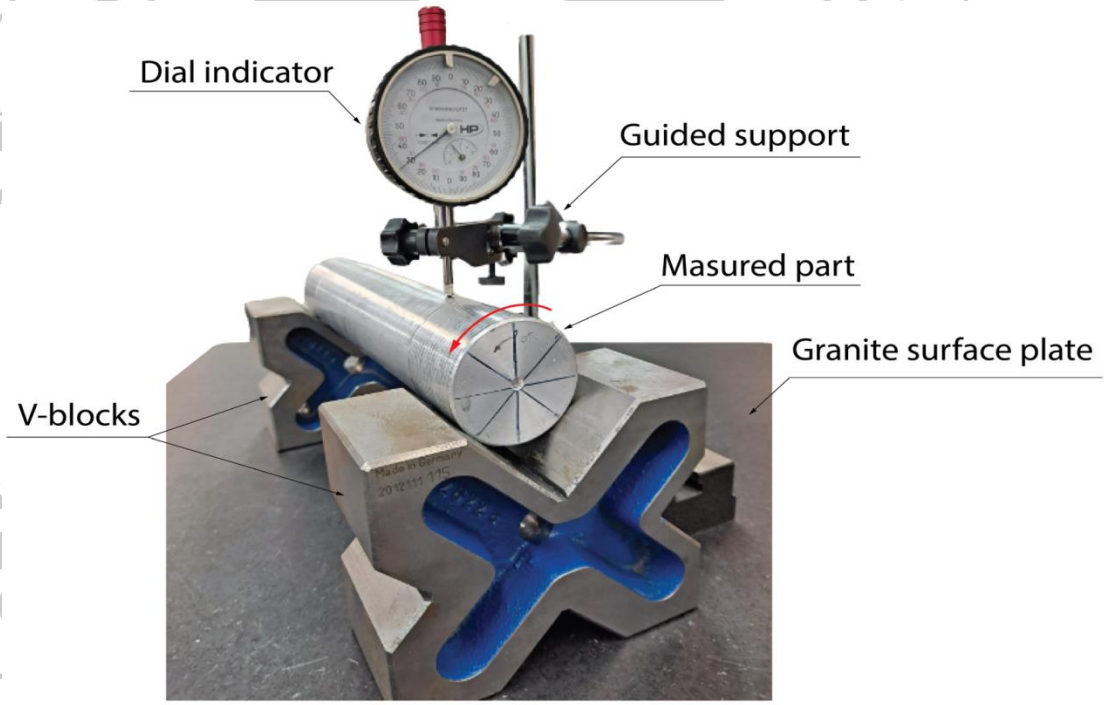


Figure-3.1 Experimental Setup

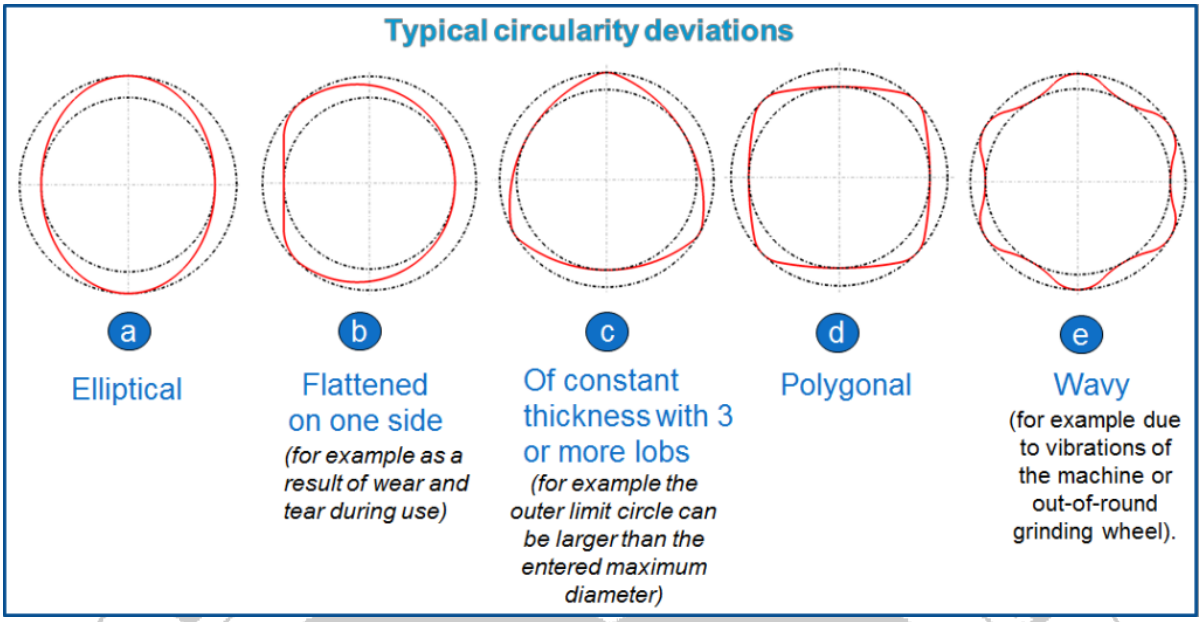


Figure-3.2 Typical Roundness Deviations

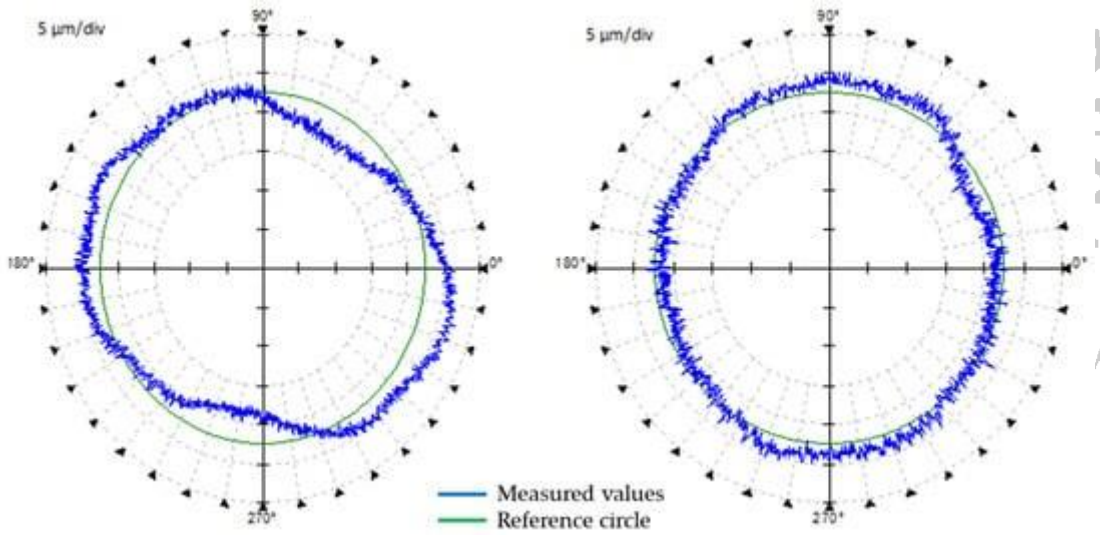


Figure-3.3 Profile Graph of Roundness Testing

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Dial gauge	Range 0 - 25 mm	1
2.	V – Block	56 x 75 x 75 Sizes in mm (W x L x H)	2
3.	Magnetic stand	Base size (L x W x H): 59 x 50 x 55 mm Total height: 425 mm Fine adjustment °: ±4	1
4.	Surface plate	Granite (200 x 200 x 50)	1

IX. Precautions to be Followed

- Set Pointer of dial gauge to zero
- The accuracy of the Instrument must be checked before using

X. Procedure

1. Measure the diameter of job with the help of Vernier caliper.
2. Place the round job over V Block
3. Mark measuring points (atleast36) on the circumference of a job
4. Place the plunger of dial indicator on job over a marking.
5. Rotate the job until plunger place over another marking point.
6. Repeat the procedure until one complete revolution.
7. Note down the readings at each marking point.
8. Plot a graph taking base value of job equal to diameter of job

XI. Observations and Calculations

Diameter of job = mm

Position	Deviation in Dial Indicator mm	Position	Deviation in Dial Indicator mm	Position	Deviation in Dial Indicator mm	Position	Deviation in Dial Indicator mm
1		10		19		28	
2		11		20		29	
3		12		21		30	
4		13		22		31	
5		14		23		32	
6		15		24		33	
7		16		25		34	
8		17		26		35	
8		18		27		36	

Draw Profile graph of above readings on graph paper (X-axis= positions, Y-axis= deviation in dial indicator)

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define Roundness
2. State the importance of roundness checking with suitable examples
3. Explain working principle of dial indicator
4. State the application of mechanical comparator

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?app=desktop&v=FqSJhY_lctc

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 04 *Measurement of unknown angle of a component using Sine bar and verify by using Bevel protractor.

I. Practical Significance

A sine Bar is a high precision and most accurate angle measuring instrument; it is used in conjunction with set of slip gauges. This bar is made up of high carbon high chromium Steel. It is kept on two hardened rollers of accurately equal diameter at a fixed distance. They are available in 100mm, 200mm, and 300mm.

Angular Bevel protector is a simplest instrument used for measuring the angle between the two faces of a component. It consists of a base plate attached to the main body and an adjustable blade attached, which in turn attached to a circular plate containing the Vernier scale. Clinometer is a special case of the application of spirit level. The clinometer is mainly used to measure the included angle between two adjacent faces of the work pieces.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/ Employer

- Measurement of the angle

III. Course Level Learning Outcome (CO)

- CO3-Select angular measuring instrument for given component and calculate unknown angle.

IV. Laboratory Learning Outcome(s)

- Use bevel protractor and sine bar for measurement of unknown angle
- Operate bevel protractor and sine bar for angle measurement

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

Sine bar is a precision instrument used along with slip gauges for accurate angle measurement or angle setting. Sine bar consists of an accurate straight bar in which two accurately lapped cylindrical plugs or rollers are located with extreme position. The straight bar are made of high carbon, high chromium, corrosion resistant steel and the surfaces are hardened, grounded and lapped. Ends of the straight bar are stepped so that the plugs can be screwed at each step. Plugs are the two rollers of same diameter fixed at a distance L between them and is called as length of the bar. This distance L is the centre to centre distance of plugs is which are generally 100, 200, and 300 mm and so on.

VII. Experimental Setup

Figure-4.1 Slip Gauge Box

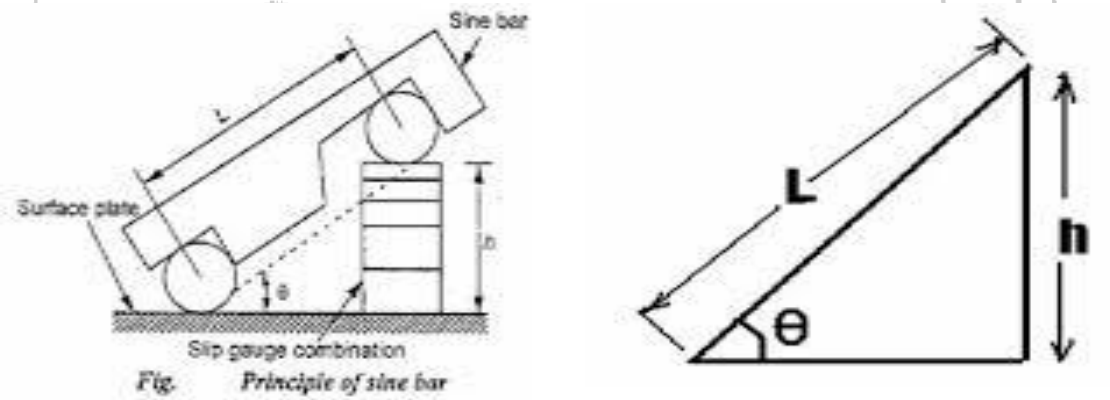


Figure-4.2 Principle of Sine Bar

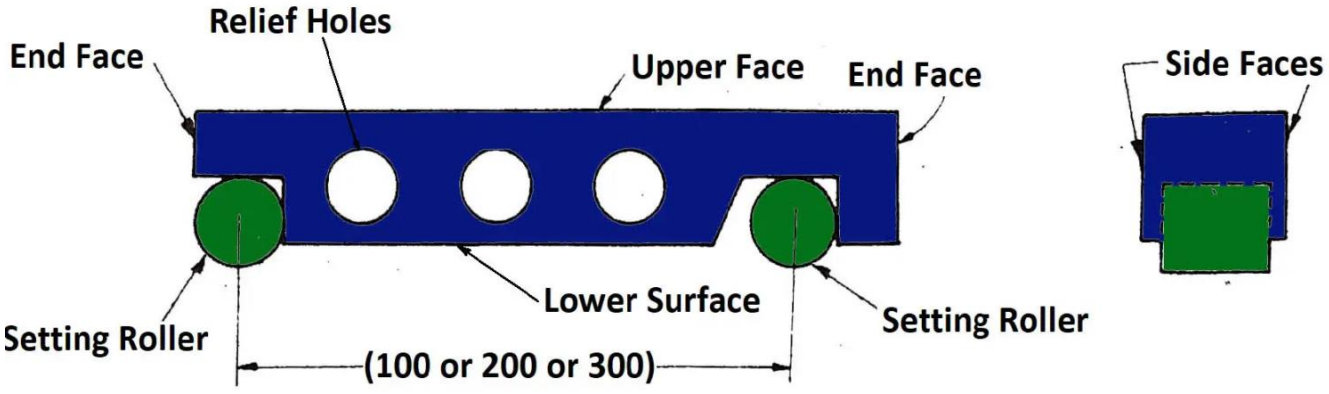


Figure-4.3 Sine Bar

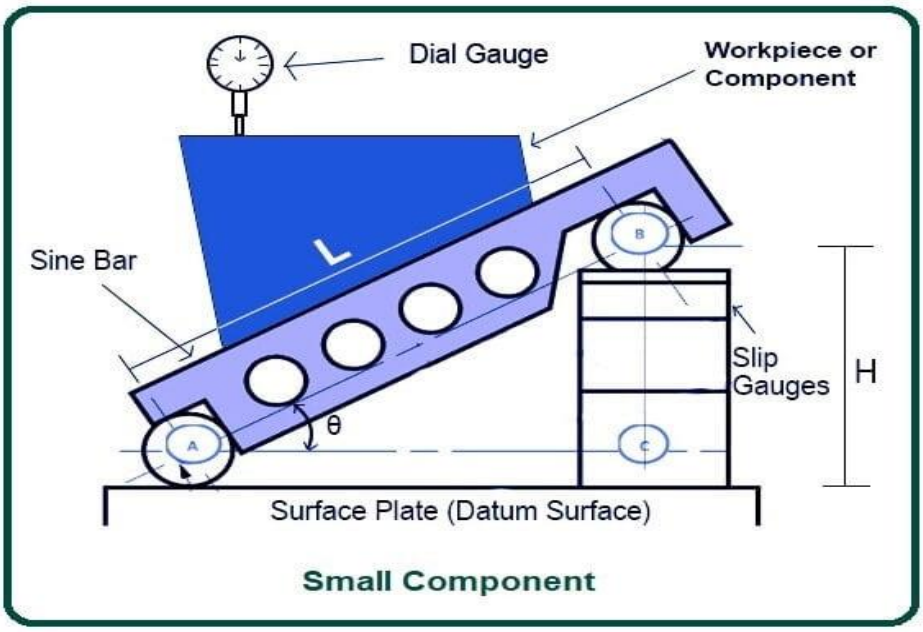


Figure-4.4 Experimental Setup

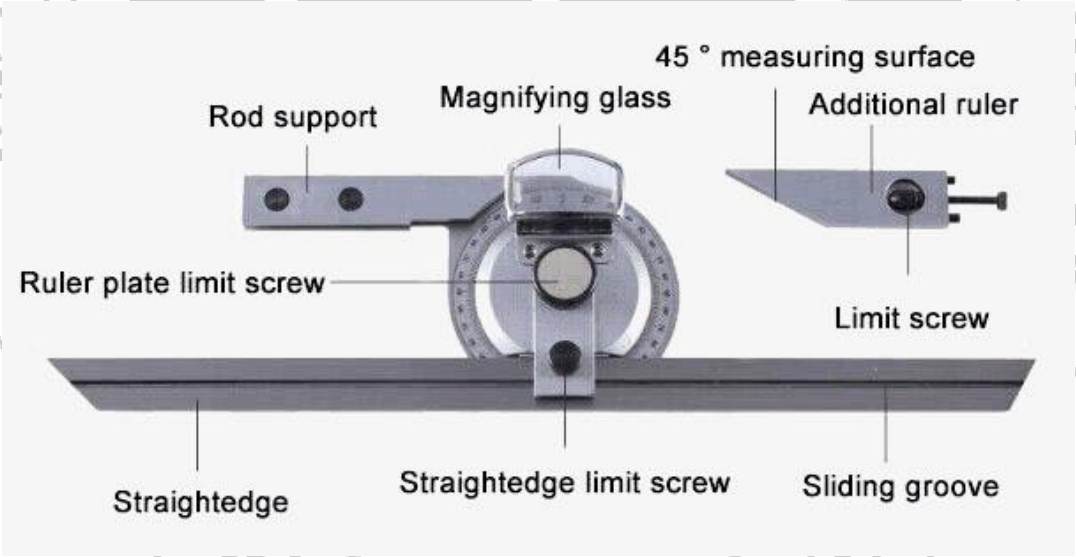


Figure-4.5 Universal Bevel Protractor

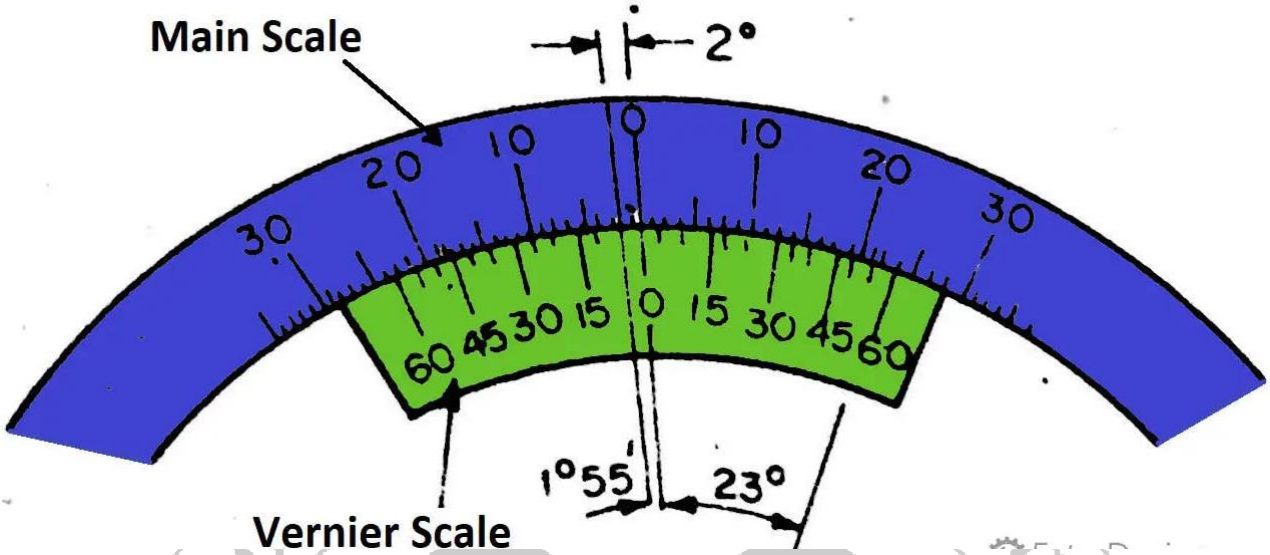


Figure-4.6 Principle of Universal Bevel Protractor

VIII. Resources Required

Sr. No. Name of Resource	Name of resource	Suggested Broad Specification	Quantity
1 Slip gauges	Slip gauges	Grade 0	1
2	Sine Bar	100mm or 200 mm size	1
3	Surface plate	Granite plate 200mm x 200mm	1
4	Dial Indicator	0-25mm size	1
5	Dial Indicator Stand		1
6	Universal Bevel Protractor	Graduation:5min.(0°-90°-0°) Accuracy Vernier: ±5' Straightness [.00016"+(.00005xL/2)]" Parallelism [.00016"+(.00005xL/2)]" L = Length in inch Diameter: 2.56" I 70mm	1

IX. Precautions to be Followed

- Surface of slip gauge must be covered with natural petroleum jelly
- Wringing of gauges should be done without applying undue pressure
- Never drop slip gauges
- Use minimum number of slip gauges for building up size combination
- Sine bars should not be used for the angles more than 45 degree
- Avoid improper handling of instrument

X. Procedure

A. Sine Bar

1. Note the length of Sine Bar L= mm
2. Find the approximate angle using Bevel protractor Θ =
3. Calculate Height of slip gauge (h) , sin Θ = h/L =
4. Select the Slip gauge pieces
5. Wring the slip gauge pieces for dimension of 'h'
6. Place the work piece on Sine bar
7. Dial indicator is to clamped to the stand and place plunger over work piece with slight pressure
8. To check the parallelism of upper surface of work piece, a dial indicator along with stand is moved from one end to another end
9. Note the deviation δΘ = degree
10. Calculate δh, tan δΘ = δh /L, δh =
11. Add or Remove slip gauges of height oh as per dial indicator deviation
12. Now move dial indicator over the work piece, there is no deviation
13. Unknown angle Sin Θ_1 = [(h+ δh)/L] =

B. Bevel Protractor

1. The fixed blade of the bevel protractor is made to coincide with the reference surface of work piece.
2. Move the movable blade of protractor to coincide with outer surface.
3. The angle between the blades is taken from protractor after noting main scale and vernier scale reading.

   Angle between the faces is given by

   A= main scale reading+ L.C. x (Vernier scale reading) Least Count of the Protractor= 5 minute

XI. Observations and Calculations

- Length of Sine Bar "L" = mm
- Angle Θ (ºdegree) =
- SinΘ = h/L =
- Height of Slip gauges "h" = mm
- Deviation angle "δΘ" =
- tan δΘ = δh / L =
- Unknown angle Sin Θ_1 = [(h+ δh)/L] =
- Angle measured with the help of Bevel protractor [degree (º) & minute(′)] =

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State the function of sine bar
2. Explain the use of bevel protractor

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=oJFUI_FHlio
- https://www.youtube.com/watch?v=xomoEQR9Vds

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 05 *Measurement of the screw thread elements by using floating carriage micrometer and verification by optical profile projector.

I. Practical Significance

Floating Carriage micrometer is used for measuring the minor, major and effective diameter of screw thread. It is a high precision instrument with a least count of 0.2 microns. Two wire methods are generally used to measure effective, minor and major diameter of screw thread. A large micrometer head and fudicial indicator mounted on a floating carriage constrained to move at right angle to the axis.

Optical profile projector is an optical instrument in which a shadow image of the outline contour of the thread, projected by a beam of light is observed through the eyepiece of optical head.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/Employer

- Measure the various elements of screw thread element

III. Course Level Learning Outcome (CO)

- CO3-Calculate screw thread parameters using given methods

IV. Laboratory Learning Outcome(s)

- Use floating carriage micrometer for measurement of major, minor, and effective diameter of screw thread
- Operate optical profile projector for checking thread profile

V. Relevant Affective Domain related Outcomes

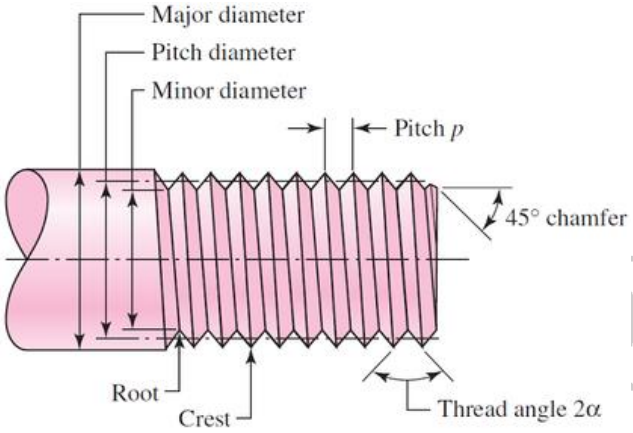
- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

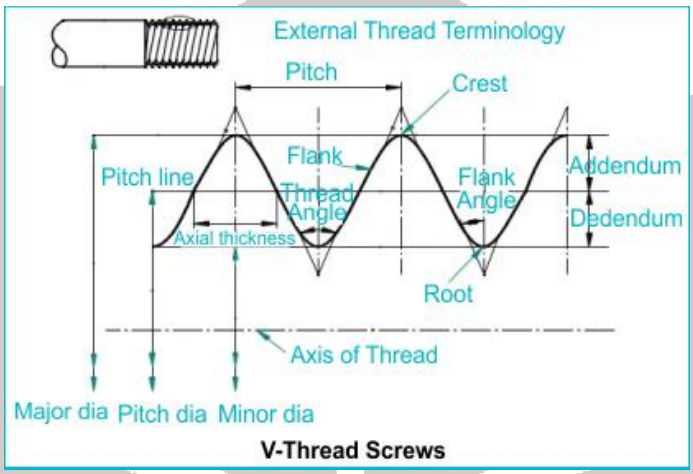
1. Major diameter- It is the diameter of the imaginary co-axial cylinder that just touches the crest of an external thread
2. Minor Diameter- It is the diameter of the cylinder that just touches the root of an internal thread
3. Effective diameter- It is a diameter of the imaginary co-axial cylinder which increases the surface of thread in such a manner that the intercept on a generator of cylinder, between two points where it meets the opposite flanks of a thread groove.
4. Crest-it is the prominent part of thread, whether internal or external
5. Root- It is the bottom of the groove between two flanking surface of the thread

6. Pitch of Thread- it is the distance measured parallel to its axis between corresponding point on adjacent surface in the same axial plane

VII. Experimental Setup



Terminology of Screw Threads



V-Thread Screws

Figure 5.1 Screw Thread Terminology

Figure 5.2 Standard Wire Box

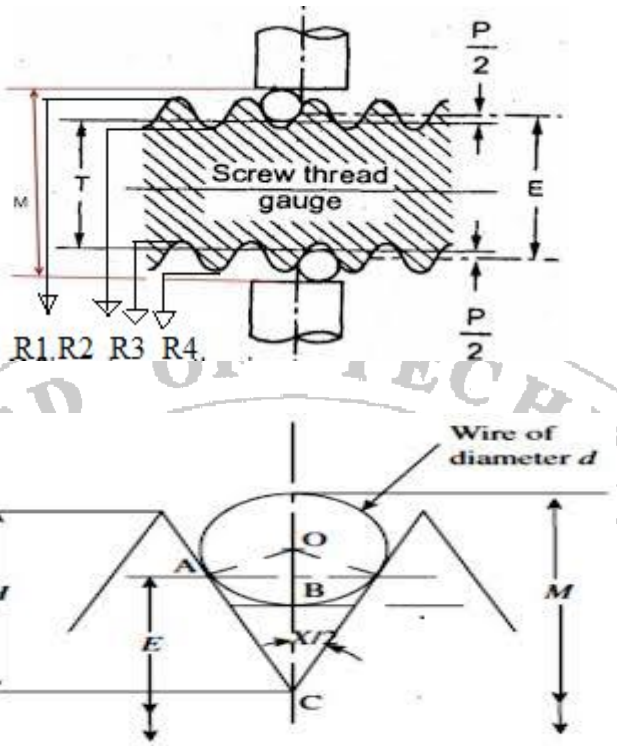
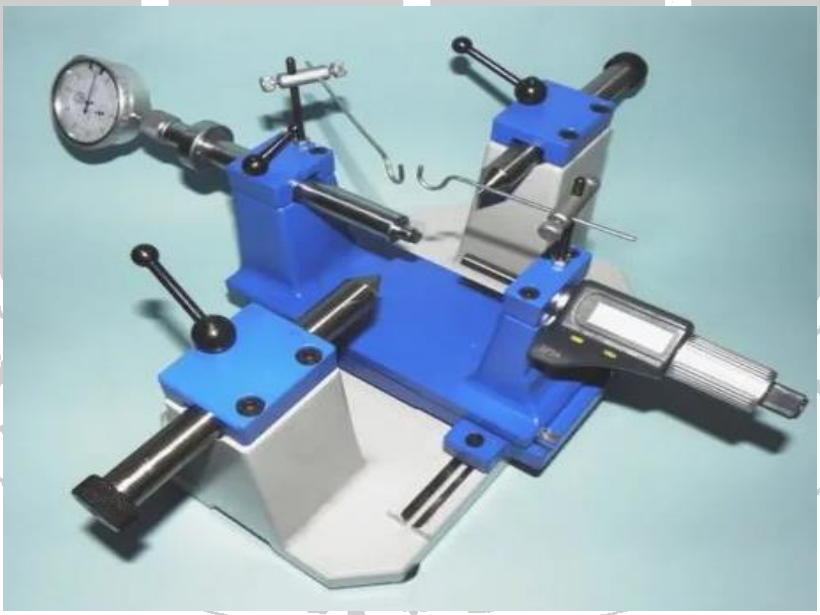


Figure 5.3 Two Wire Method Setup



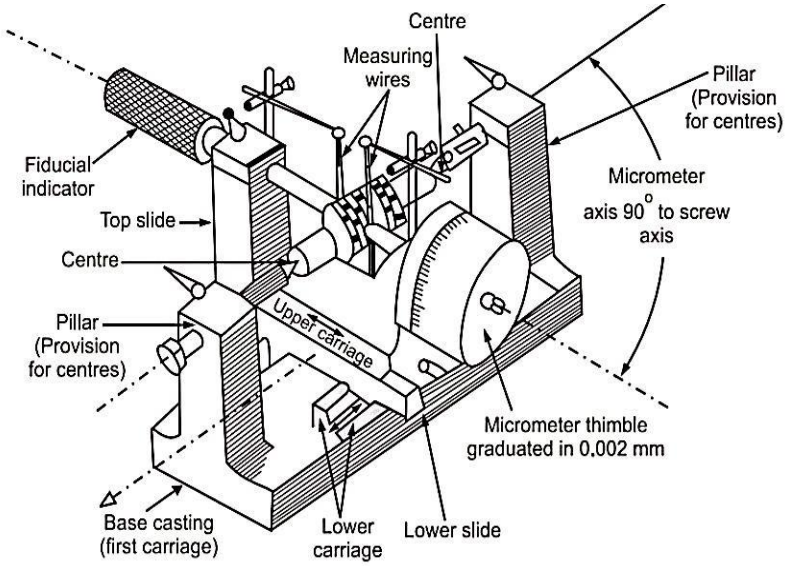


Figure 5.4 Floating Carriage Micrometer

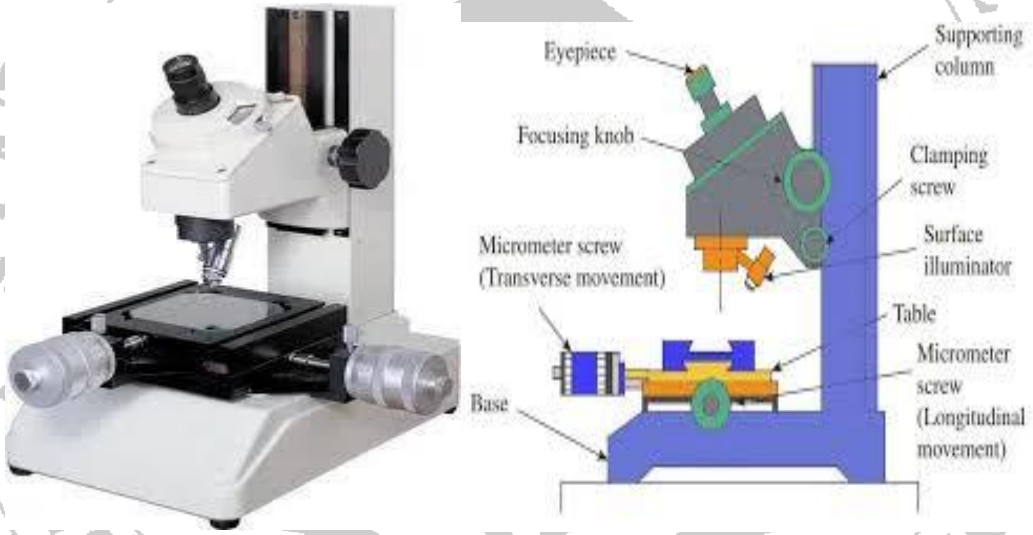


Figure 5.5 Tool Maker's Microscope

VIII. Resources Required

Sr. No	Name of Resource	Suggested Broad Specification	Quantity
1	Floating Carriage Micrometer	• **Range:** 0-l00mm/0-4" & 0-l 75mm/0-7". • **Resolution:** 0.0002mm/ 0.0001 mm • **Repeatability:** 0.002 mm/0.0002 mm • **Accuracy:** 0.004mm/ 0.002mm with PIO probe • Accessories: Thread Measuring wires, Prisms, Cylindrical masters & Taper thread plug attachment.	1

Sr. No	Name of Resource	Suggested Broad Specification	Quantity
2	Optical profile projector	• X.Y Axis Travel: 50x50 mm • Maxi Working Height: 115 mm • Maxi Loading Weight: 5kgs • Measuring Head: Mechanical Measuring Head • Resolution Of Measuring Head: 0.001 mm • Machine Head: Monocular (Aimer Is Adjustable) • Angle Dial: Rotary Angle: 360°; Minimum Angle Reading: 6' • Eyepiece (176-116): 15x • View Diameter: 13 mm • Objectives (176-138): 2x Working • Diameter: 67 mm • Total Magnification: 30 x Contour Illumination: 24v/3v Tungsten Bulb With Green Filter Surface Illumination: 24v/3v Tungsten Bulb	1

IX. Precautions to be Followed

- Avoid improper handling of instrument
- Don't apply excessive pressure on Micrometer anvils

X. Procedure

A. floating carriage micrometer for measurement of effective diameter

1. Select the set of standard wire anvils and setting cylinder of as size nearer to size of work piece
2. Hold setting cylinder between centers
3. Hang the standard wire on stands provided with floating carriage micrometer
4. Apply the pressure over anvil until fudicial indicators shows zero reading
5. Note the reading on thimble as initial reading 'Rs'
6. Replace a setting cylinder by a screw thread/thread plug gauge
7. Insert the standard wire in root of the thread
8. Apply the pressure over anvil until fudicial indicators shows zero reading
9. Note the reading on thimble as final reading “Rt"
10. Calculate the diameter over wire “Do”
    Do= Ds +/- (Rs - Rt)
    Ds= Diameter of setting cylinder
11. Effective Diameter “De”

De = Do – 2d+ P

P= 0.866p - d (metric Thread)

d= diameter of wire

p = Screw thread pitch

B. Floating carriage micrometer for measurement of major diameter

1. Select the set of flat anvil and setting cylinder of as size nearer to major diameter of work piece
2. Hold setting cylinder between centers
3. Set the anvil of micrometer and take reading by floating carriage micrometer
4. Apply the pressure over anvil until fudicial indicators shows zero reading
5. Note the reading on thimble as initial reading 'Rs'
6. Replace a setting cylinder by a screw thread/thread plug gauge
7. Insert the flat anvil at the crest of the thread
8. Apply the pressure over anvil until fudicial indicators shows zero reading
9. Note the reading on thimble as final reading "Rt"
10. Calculate the major diameter = D = Ds +/- (Rs - Rt)
    Ds= diameter of setting cylinder

C. Floating carriage micrometer for measurement of minor diameter

1. Select the set of V- anvil (having 45-degree angle) and setting cylinder of as size nearer to minor diameter of work piece
2. Hold setting cylinder between centers
3. Set the V- anvil of micrometer take reading by floating carriage micrometer
4. Apply the pressure over anvil until fudicial indicators shows zero reading
5. Note the reading on thimble as initial reading "Rs"
6. Replace a setting cylinder by a screw thread/thread plug gauge
7. Insert the V- anvil at the root of the thread
8. Apply the pressure over anvil until fudicial indicators shows zero reading
9. Note the reading on thimble as final reading "Rt"
10. Calculate the minor diameter (Root diameter) =Dr= Ds +/- (Rt - Rs)
    Ds= diameter of setting cylinder

D. Profile projector

1. Connect Power supply to the Microscope
2. A light source at the base provides a horizontal beam of light and is reflected from a mirror 90 deg. towards the working table
3. Set threaded object between centers on the working table
4. Set threaded object below the optical head by longitudinal and lateral movement of the table
5. Adjust optical head tube in height for focusing purposes till a sharp image of the projected counter is seen on the screen
6. For the measurement of major, minor and effective diameter of screw thread,

set clear image of the crest and root point of the thread.

7. Take the reading R1, R2, R3, R4 on thimble of longitudinal micrometer screw by transverse the object at each crest and root point of same thread.
   Upper crest of thread = R1
   Lower crest of thread = R4
   Upper root of thread = R2
   Lower root of thread = R3
8. For measurement of major and minor diameter do calculations as per follow
   Major diameter = R1- R4
   Minor diameter = R2- R3
9. For measurement of effective diameter of screw thread, trace the image of screw thread on tracing paper and cut screw thread in such a way that screw thread thickness and space between two thread are equal and measure diameter.

XI. Observations and Calculations

a. Measurement of Effective diameter by using floating carriage micrometer

Sr. No	Diameter of Setting Cylinder mm	Reading on Threaded Object mm	Reading on Setting Cyliner mm	Diameter over the Wire mm	Effective diameter mm
	Ds	Rt	Rs	Do= Ds + / - (Rs - Rt)	De = Do-2d+P
1					
2					
3					

b. Measurement of major diameter by using floating carriage micrometer

Sr. No	Diameter of Setting Cylinder mm	Reading on Threaded Object mm	Reading on Setting Cylinder mm	major diameter mm
	Ds	Rt	Rs	D= Ds +/- (Rs - Rt)
1				
2				
3				

c. Measurement of minor diameter by using floating carriage micrometer

Sr. No	Diameter of Setting Cylinder mm	Reading on Threaded Object mm	Reading on Setting Cylinder mm	Root diameter (Minor diameter) mm
	Ds	Rt	Rs	Dr= Ds + (Rt - Rs)
1				
2				
3				

d. Measurement of Major, Minor, Effective diameter by using optical profile projector

Sr. No	Reading at Crest 'Rl' mm	Reading at Root 'R2' mm	Reading at Root 'R3' mm	Reading at Crest 'R4' mm	Major diameter mm (R1-R4)	Minor Diameter mm (R2-R3)	Effective Diameter mm
1							
2							
3							

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State the function of fudicial indicator
2. Explain two wire methods for the measurement of effective diameter
3. List the other jobs that can be measured on optical profile projector

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=Jd5Kx4hMgiQ
- https://www.youtube.com/watch?v=ciuix80_430
- ttps://www.youtube.com/watch?v=A30Wq3nE2 l Y
- https://www.youtube.com/watch?v=XlZ6iamb9Yc

XVII. Rubrics for Assessment Scheme

	Performance Indicators	Weightage
	Process Related (15 Marks)	**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
	Product Related (10 Marks)	**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 6 *Measurement of the gear tooth elements using gear tooth vernier caliper and verification by optical profile projector

I. Practical Significance

Gears are Mechanical devices that transmit power and motion in a wide verity of commercial and industrial applications. They are widely used in speed reduction, torque multiplication and accuracy enhancement for positioning system. Transmission efficiency of gear is 99%, efficiency of gear depends upon the dimension of gears. Optical profile projector is an optical instrument in which a shadow image of the outline contour of the thread, projected by a beam of light is observed through the eyepiece of optical head.

II. Industry/Employer Expected Outcome

- This practical is expected to develop the following skills for the industry/Employer
- Measure the various elements of gear tooth

III. Course Level Learning Outcome (CO)

- CO3-Explain procedure of measuring the given parameters of gear

IV. Laboratory Learning Outcome(s)

- Measure face width and tooth thickness of a gear by using gear tooth vernier caliper
- Operate optical profile projector for measuring gear profile

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

Pitch Circle diameter (PCD) - It is the diameter of an imaginary circle which produces purely rolling action the same motion as that of the actual gear.

PCD = (N x OD) / (N+2),

N = Number of teeth,

OD = Outside diameter

Module- (m) - It is the ratio of PCD to the number of teeth m=PCD/N

Circular pitch (PC) - It is the distance measured on the circumference of the pitch circle from a point of one tooth to the corresponding point on the next tooth PC= πD/N

Addendum - The radial distance of the tooth from the pitch circle to the top of the tooth

Dedendum- The radial distance of the tooth from the pitch circle to the bottom of the tooth

Dedendum = addendum + clearance

= m+0.157m

Tooth Thickness - It is the arc distance measured along the pitch circle from the intercepts with one flank to the intercepts with other flank of the same tooth.

VII. Experimental Setup

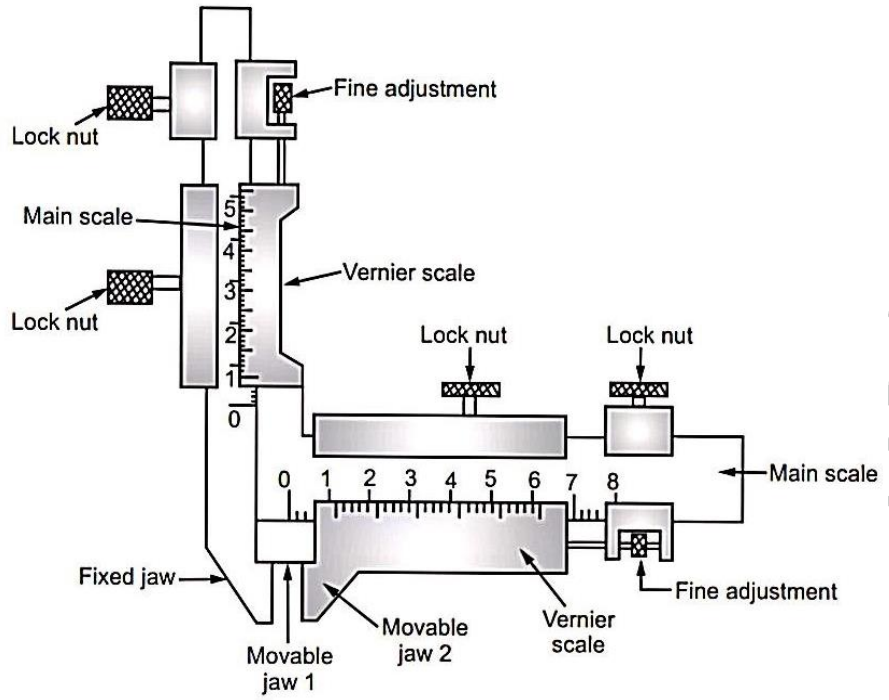


Figure-6.1 Gear Tooth Vernier Caliper

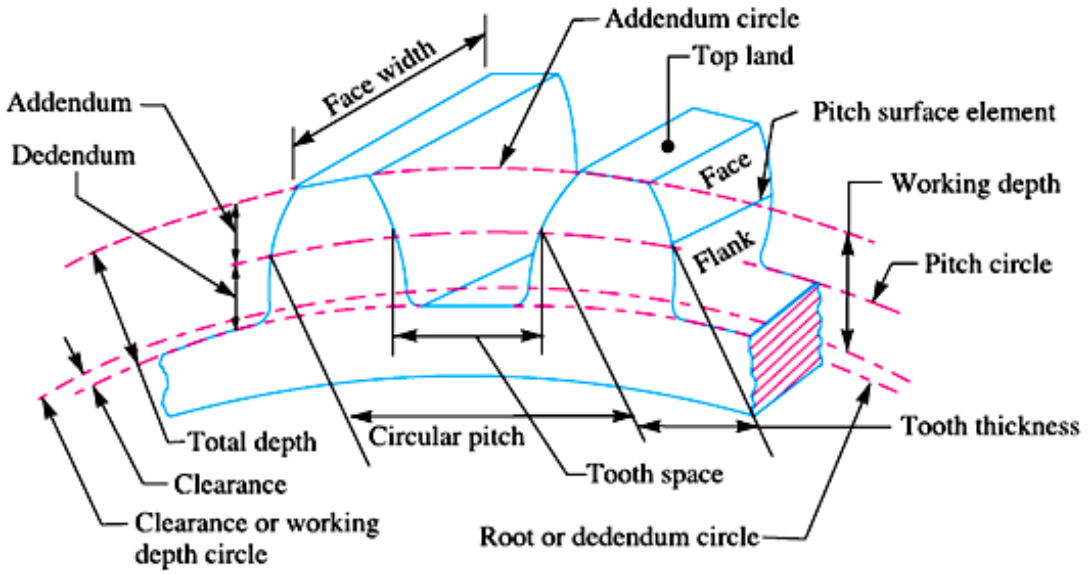


Figure-6.2 Gear Terminology

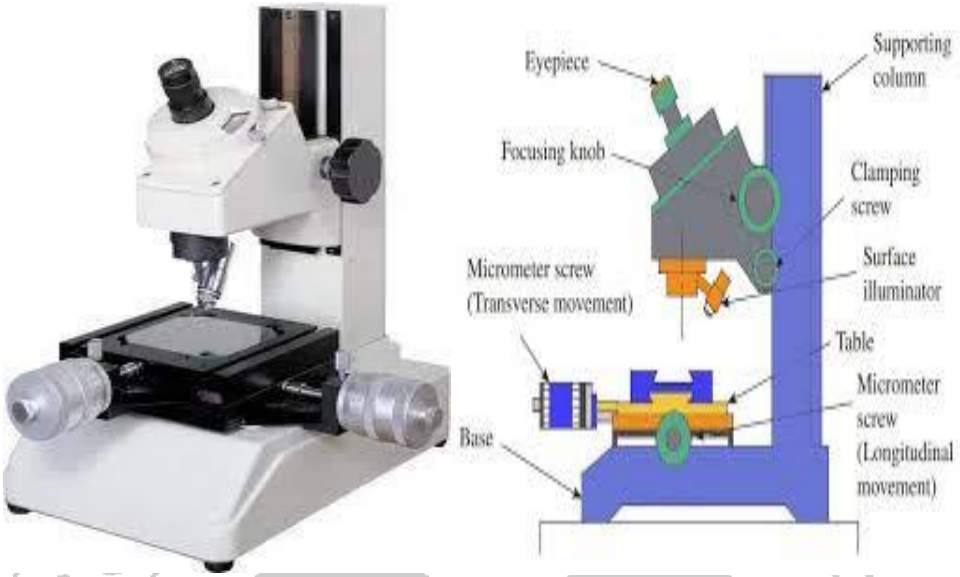


Figure-6.3 Tool Maker's Microscope

VIII. Resources Required

Sr. No.	Name of resource	Suggested Broad Specification	Quantity
1	Gear tooth vernier caliper	0-150 mm	1
2	Vernier caliper	0- 200 mm	1
3	Optical profile projector	• X.Y Axis Travel: 50x50 mm • Maxi Working Height: 115 mm • Maxi Loading Weight: 5kgs • Measuring Head: Mechanical Measuring Head • Resolution of Measuring Head: 0.001 mm • Machine Head: Monocular (Aimer Is Adjustable) • Angle Dial: Rotary Angle: 360°; Minimum Angle Reading: 6' • Eyepiece (176-116): 15x • View Diameter: 13 mm • Objectives (176-138): 2x Working • Diameter: 67 mm • Total Magnification: 30 x • Contour Illumination: 24v/3v Tungsten Bulb With Green Filter Surface Illumination: 24v/3v Tungsten Bulb	1

IX. Precautions to be Followed

- Avoid improper handling of instrument
- Don't apply excessive pressure on measuring jaws and anvils
- Don’t apply excessive pressure on Micrometer screw

X. Procedure

a. For Gear tooth vernier caliper

1. Find Blank Diameter by Vernier Caliper OD= mm
2. Count Number of Teeth 'N' =
3. Calculate PCD = (N x OD)/ (N + 2)=
4. Calculate module m= PCD/ N =
5. Set the Chordal depth (addendum-'d') on the vertical side of gear tooth Vernier
6. d = (N. m/2) [1 + (2/N) – cos(90/N)] = mm
7. Insert the jaws of the caliper on the tooth to be measures
8. Adjust the horizontal Vernier side by the fine adjusting screw so that the jaws just touch the tooth
9. Read the horizontal Vernier side, it gives chordal thickness of the tooth = w = mm
10. Find out theoretical value of chordal thickness (w)=N.m.sin(90/N)

b. By using Optical profile projector

1. Connect Power supply to the Microscope
2. A light source at the base provides a horizontal beam of light and is reflected from a mirror 90 deg. towards the working table
3. Set threaded object between centers on the working table
4. Set threaded object below the optical head by longitudinal and lateral movement of the table
5. Adjust optical head tube in height for focusing purposes till a sharp image of the projected counter is seen on the screen
6. For the measurement of chordal thickness, the image of the profile is set at chordal depth “d” point of the same gear teeth profile coincides with the cross hair.
7. Note the reading of thimble of longitudinal micrometer screw ‘R1’.
8. Transverse the object by a micrometer screw until the corresponding point on the profile of same teeth coincides with cross hair.
9. Note the reading of thimble of longitudinal micrometer screw ‘R2’.
10. The difference between two micrometer reading is nothing but chordal thickness (w)

XI. Observations and calculations

a. Using Gear Tooth Vernier Caliper

Sr. No	Practical Chordal Thickness (w) mm			
	Reading 1	Reading 2	Reading 3	Avg. Reading
Teeth 1				
Teeth 2				
Teeth 3				

b. Using optical profile projector

Sr. No.	Initial Micrometer Scale reading R1 mm	Final Micrometer Scale reading R2 mm	Difference in reading = chordal thickness w =R1-R2 mm
1			
2			
3			

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define ' module' and Pitch Circle diameter
2. State the relationship between addendum and Dedendum
3. State the industrial applications of optical profile projector

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=BIE8_IxM2pA
- https://www.youtube.com/watch?v=VOBsmyGfH_o
- https://www.youtube.com/watch?app=desktop&v=DXsFtazwdI
- https://www.youtube.com/watch?v=Kdf0F7uPWG0

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 7 *Measurement of the Surface Roughness of machined component surface by using Surface Roughness Tester

I. Practical Significance

Taylor Hobson Talysurf is a device used for measurement of surface finish with a high accuracy. The device is initially calibrated with a standard work piece.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/ Employer

- Select relevant surface testing methods.

III. Course Level Learning Outcome (CO)

- CO3-Describe procedure for examining surface finish of the given component

IV. Laboratory Learning Outcome(s)

- Examine the machined surface using surface roughness tester

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

The Talysurf is an electronic instrument working on carrier modulating principle. The measuring head of the instrument consist of a diamond stylus of about 0.002mm tip radius skid is drawn across the surface by means of motorized driving unit. It provides three motorized speeds giving 20X,100X magnification and speed suitable for average reading.

VII. Experimental Setup-

Figure 7.1 Talysurf

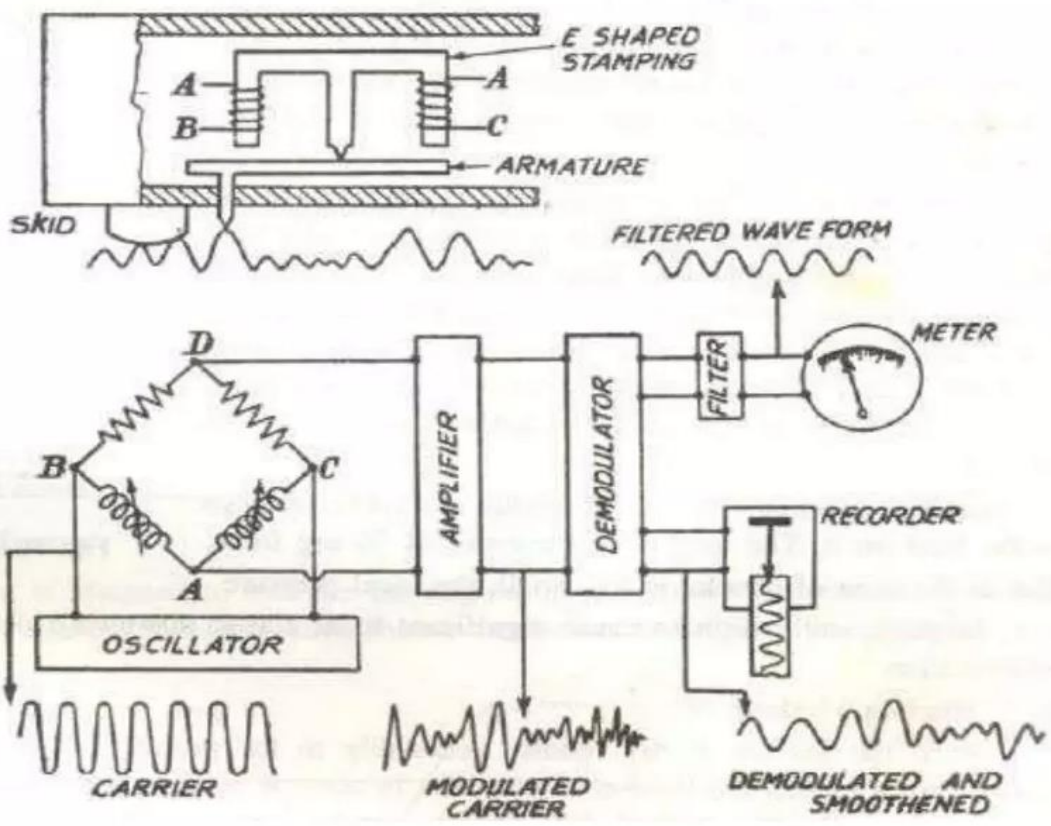


Figure 7.2 Layout of Talysurf

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Taylor Hobson Talysurf	• Span length- 0.8mm, • Diamond stylus, • Digital Reading • Sample work piece for all machining process • Samples showing all surface roughness value	01

IX. Precautions to be Followed

- Avoid improper handling of Talysurf
- Don't apply pressure on stylus of the instrument

X. Procedure

1. Calibrate the Talysurf using standard piece
2. Clean the surface under test
3. Place the probe on the surface which is to be tasted
4. ON the Talysurf

5. Observe the display of 'Ra' value
6. Note the "Ra" value reading displayed
7. Repeat the procedure for various surfaces of the components

XI. Observations and calculations

Component No.	Manufacturing Process used	'Ra' Value µm	Average 'Ra' µm
1			
2			
3			

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define "Ra" value
2. State the principle of Talysurf.

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=9zk7aKYbCYM

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 8 Measurement of Flatness of Given Component by Using Optical Flat

I. Practical Significance

Flatness testing of a work piece is done by observing the fringe pattern by interference of two monochromatic light rays reflected from, lower surface of top optical flat and upper surface of lower flat surface through very fine air gap between two flats.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/Employer

- Select relevant flatness measuring testing methods

III. Course Level Learning Outcome (CO)

CO3-Describe procedure for examining flatness of the given component

IV. Laboratory Learning Outcome(s)

- Use different optical flats for measurement of surface flatness
- Identify the types of observed fringe patterns of optical flats

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

The essential equipment by light wave interference is a monochromatic light source and a set of optical flat. An optical flat is a circular piece of optical glass or fused quartz having its two planes faces flat and parallel. The surfaces are finished to an optical degree of flatness. If the optical flat form an intimate contact and placed in monochromatic light source, then the bands are visible.

VII. Experimental Setup-

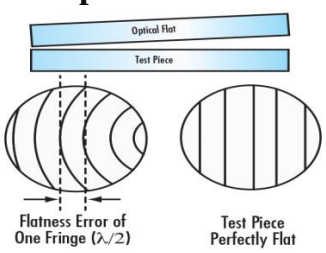


Figure-8.1 Fringe Pattern

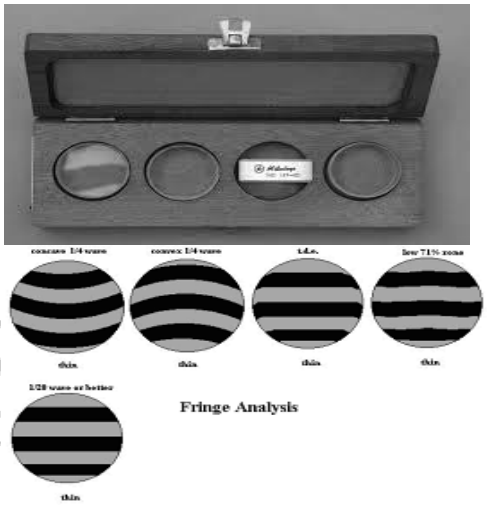


Figure-8.2 Optical Flat

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Monochromatic Light Source	Sodium vapour light	01
2.	Optical flat Set	Convex, Concave, flat, Cylindrical, Turf type optical flat	1 set

IX. Precautions to be followed

- Avoid improper handling of optical flat
- Don't apply pressure on optical flat

X. Procedure

1. Keep Optical flat on, master piece
2. Apply pressure by two fingers so that there should not be any air gap
3. Observe the fringe pattern
4. Keep optical flat once again on same surface and apply pressure gently so that some air gap exist
5. Observe the fringe pattern
6. When fringes are perfectly straight and same fringe width for dark and bright band we conclude that the surface is perfectly flat
7. Keep optical flat on convex surface
8. Apply pressure gently so that some air gap exist
9. For convex surface the fringes curve around the point of contact

10. Keep optical flat on concave surface
11. Apply pressure gently so that some air gap exist
12. For concave surface the fringes curve away from the point of contact

XI. Observations and calculations

Sample No	Fringe Pattern Observed	Nature of surface (Convex, concave, cylindrical, flat etc.)
1		
2		
3		

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Name the commonly used monochromatic light sources
2. State the uses of optical flats

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=ZJLTVuo9FJo

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	T**otal**	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 9 Measurement of unknown angle of a given component by Autocollimator / Angle Dekkor

I. Practical Significance

An Angle Dekkor is a small variation of the autocollimator. This instrument is essentially used as comparator and an optical instrument used for the measurement of small angular differences of the reflectors in two planes.

II. Industry/Employer Expected Outcome

This practical is expected to develop the following skills for the industry/Employer

- Measurement of sloping angle of V- blocks
- Calibration of taper gauges
- Measurement of angles of conical parts
- Test the angle / taper of a given job

III. Course Level Learning Outcome (CO)

- CO3-Describe procedure for examining angle / taper of the given component

IV. Laboratory Learning Outcome(s)

- Use Autocollimator / Angle Dekkor to measure small angle differences or measure taper of a given component.

V. Relevant Affective Domain related Outcomes

- Follow safe practices
- Practice good housekeeping
- Practice energy conservation
- Demonstrate working as a leader/a team member
- Maintain tools and equipment

VI. Minimum Theoretical Background

It consists of a small illuminated scale in the focal plane of objective lens. The illuminated scale is projected as a parallel beam of a light by a collimating lens. In the field view, there is another datum scale fixed across the Centre of the screen and the reflected image of illuminated scale is received at right angle to the fixed scale. These two scales intersect with each other The reading of illuminated scale measures the angular deviation in one axis at 90 degrees to optical axis changes in angular position in two plane are indicated by changes in points of intersection of two scales an angular deviation of 1' can be measured with the help of angle dekkor.

VII. Experimental set up-

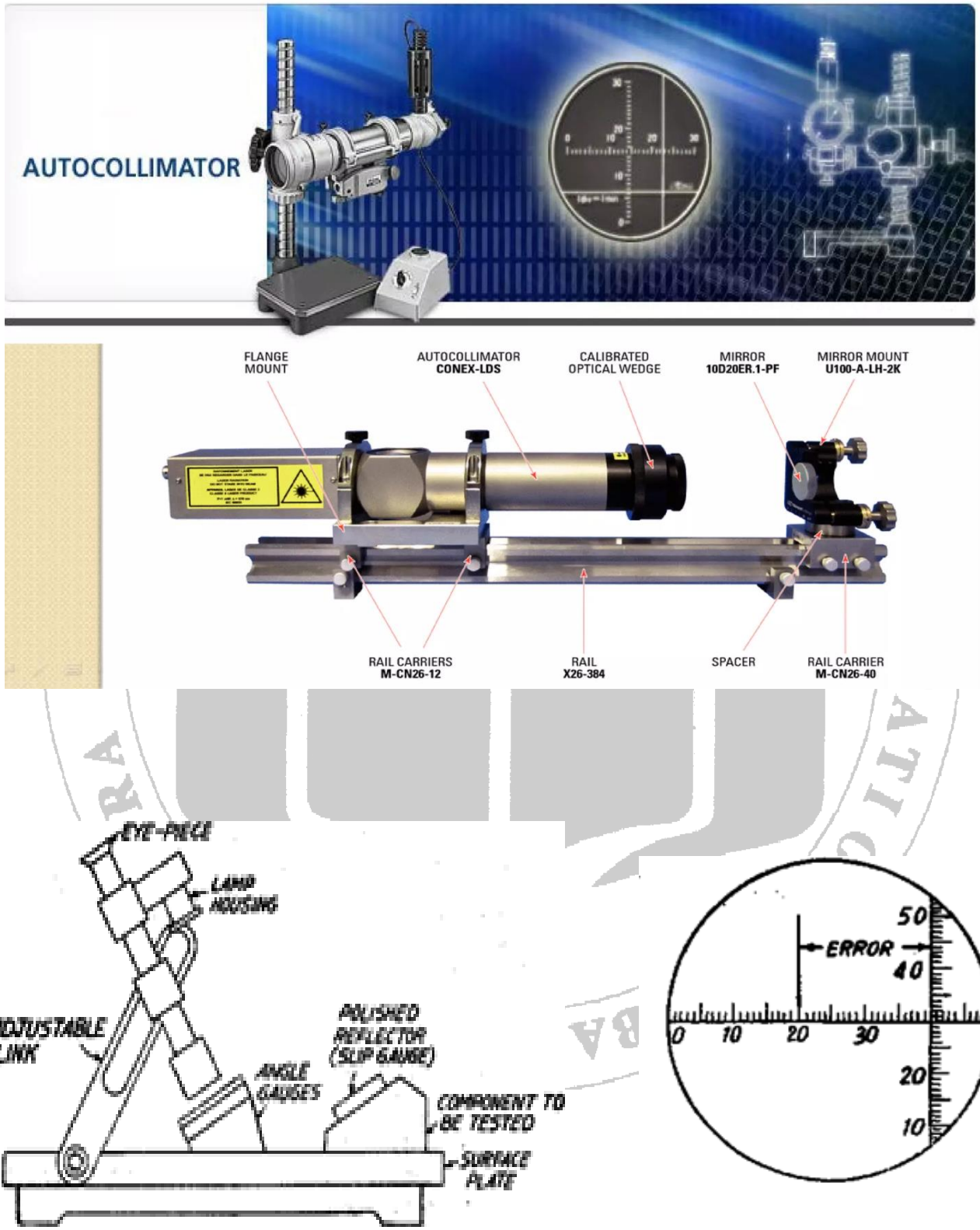


Figure-.9.1 Angle Dekkor Set up

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Angle Dekkor	• Focal Length of Objective lense: 220mm • Clear Aperture of Objective lense : 40mm • Magnification: ll X • Measuring Range: 60-0-60 minute in X- y axis. • Least Division on Reticle: 1 minute of arc • Least Division with Micrometer Drum: 2 second of arc	1
2.	Set of angle Gauges	1 set	1
3	Set of slip Gauges	1 set	1

IX. Precautions to be followed

- Avoid improper handling of instrument
- Handle eyepiece with care
- Handle Gauges with care

X. Procedure

1. Mount the angle Dekkor on adjustable bracket
2. Select the set of angle gauge
3. Set the angle Dekkor in such a way that the axis of optical system is normal to the surface of reflector
4. Set the zero reading on illuminated scale
5. Remove the angle gauge and replace it by component
6. Note down the reading of new position of reflected scale.

XI. Observations and calculations

Sr. No.	Basic size angle	Angle gauge	Reading on reflected scale	Angular deviation from Basic Size
Basic size	α	β	Θ	α +/- Θ
1.				
2.				

Sr. No. Basic size	Basic size angle α	Angle gauge β	Reading on reflected scale Θ	Angular deviation from Basic Size α +/- Θ
3.				

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State difference between auto collimator and angle Dekkor
2. State the procedure of angle Dekkor calibration

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=Vt6OWKZA3V4

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 10 *Measurement of displacement by using Linear Variable Displacement Transducer (LVDT)

I. Practical Significance

LVDT works under the principle of mutual induction and the displacement which is a non-electrical energy is converted into an electrical energy. LVDT consists of a cylindrical former where it is surrounded by one primary winding in the center of the former and the two secondary windings at the sides. The number of turns in both the secondary windings are equal, but they are opposite to each other i.e., if the left secondary windings is in the clockwise direction, the right secondary windings will be in the anti-clockwise direction, hence the net output voltages will be the difference in voltages between the two secondary coil.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure linear displacement for given application.

III. Course Level Learning Outcome (CO)-

- CO4-Select relevant instrument for measuring the physical parameters of given system.

IV. Laboratory Learnin.g Outcome(s)-

- Measure displacement of micrometer by using LVDT.
- Use LVDT for measurement of linear displacement

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background with diagram –

Displacement is also measured with differential transformers, which operate on the principle of changing inductance. The Linear Variable Differential Transformer (LVDT) is the most widely used variable inductance transducer for linear displacement measurement. Three symmetrically spaced coils are mounted on an insulated bobbin to form the LVDT. Magnetic flux coupling between coils is made possible by a magnetic core that travels through the bobbin without making contact with anything. The mutual between the two outside secondary coils and the centre, or primary coil, is determined by the location of the magnetic core. The two secondary coils that are wired in a series-opposing circuit produce voltages when an AC carrier excitation is delivered to the primary coil. The voltage induces between the two secondary coils when the core is centered between them.

VII. Experimental setup -

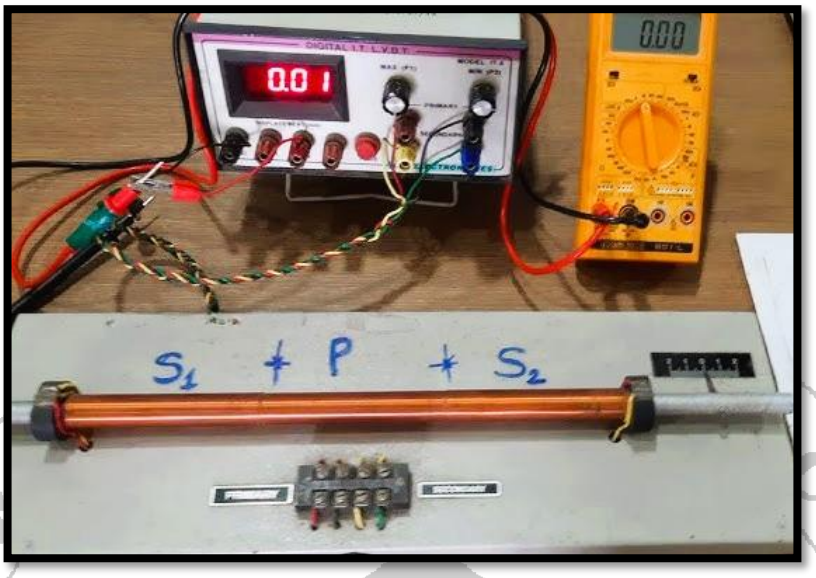


Figure-10.1- LVDT Experimental Setup

VIII. Resources Required -

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Inductive transducer	• Measurement range 0 to 100 mm. Sensor-inductive (non-linear) solenoid type on board with micrometer, micrometer screw gauge assembly for displacement, bridge balance type circuit Display 3.5 digit digital display.	1

IX. Precautions to be Followed

- Avoid improper handling of Transducer.
- Do not disturb connections.

X. Procedure

1. Connect the power supply chord at the rear panel to the 230V 50Hz supply.
2. Switch ON the instrument by pressing down the toggle switch. The display glows to indicate the instrument is ON.
3. Allow the instrument in ON position for 10 minutes for initial warm-up.
4. Rotate the micrometer till it reads “20.0.”
5. Adjust the potentiometer at the front panel so that the display reads "10.0"
6. Rotate the core of micrometer till the micrometer reads "10.0"
7. Adjust the ZERO potentiometer till the display reads "00.0."

8. Rotate back the micrometer core upto 20.0
9. Adjust once again Potentiometer till the display read.
10. As the core of LVDT moves the display reads the displacement in mm.
11. Rotate the core of the micrometer in steps of 1 or 2 mm
12. Tabulate the readings and Plot the graph of Actual V/s indicator readings.

XI. Observations and Calculations-

Sr. No.	Actual Micrometer Reading (mm)	Indicator Reading (LVDT)(mm)	Error (mm)	% Error
1				
2				
3				
4				
5				

Error = (Actual Scale Reading - Indicator Scale Reading)

% Error = (Error/ distance of Step) *100

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List the applications of LVDT.
2. Draw Characteristic curve of LVDT for output voltage.

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=8nVnsKNR6dI
- https://www.youtube.com/watch?v=85gm5aqeY44

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 11 Measurement of temperature by thermocouple and Verification by thermometer.

I. Practical Significance –

Thermocouples are active transducers that produce electromagnetic fields. It is a straightforward electrical device that senses temperature. It offers a trustworthy way to measure temperature. It is frequently used in industrial settings to keep an eye on the liquid and gaseous temperatures in pipes and storage.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure temperature of a given system.

III. Course Level Learning Outcome (CO)

- CO4 - Select relevant instrument for measuring the physical parameters of given system.

IV. Laboratory Learning Outcome(s)-

- Measure temperature of system using thermometer.
- Use thermocouple for measurement of temperature of given system.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background-

A thermocouple is essentially two different metallic wires joined together to create two junctions. A cold connection is maintained at a steady temperature, while a hot junction is heated. Measuring junction is another name for hot junction. Measuring junction is another name for cold junction.

VII. Experimental Setup-

Figure.11.1-Thermocouple Test setup

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Thermocouple Set up assembly with heating arrangement	Thermocouple, Liquid in gas Thermometer, Vessel for hot andcold junction, millimeter. Induction heater.	1
2.	Display	3.5 digital display	1
3.	Power supply	12V, 500 mA to drive A to d Converter	1
4.	Thermometer	Range 0 to 150 deg C	1

IX. Precautions to be followed

- Avoid improper handling of Thermocouple
- Stay away from heating element.

X. Procedure

1. Immerse Thermocouple hot junction and cold junction
2. Place Thermometer at hot pot
3. Keep system in 'ON' position for 10 minutes
4. Note down the temperature of Thermometer and indicator
5. Note down the EMF reading with the help of Multi meter.

XI. Observations and Calculations-

Sr. No	Indicator Reading using Thermocouple ^{o}C	EMF generate Millivolts	Actual Temperature by Thermometer ^{o}C
1			
2			
3			
4			
5			
6			

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO

1. State Seeback Effect, Peltier effect and Thomson's effect.
2. List Industrial application where temperature measurement is required.

[Space for Answer]

XVI. References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=g5OOzVcgfUQ
2. https://www.youtube.com/watch?v=w60_XskB4vA

XVII. Rubrics for Assessment Scheme

	Performance Indicators	Weightage
	Process Related (15 Marks)	**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
	Product Related (10 Marks)	**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 12 Measurement of the flow rate of liquid by rotameter.

I. Practical Significance-

The flow restriction in variable flow meters has a set size, and the flow rate determines the differential pressure across it. The most widely used type of variable area flow meter is the rotameter. The fundamental ideas, the squares of the orifice's flow area and flow rate determine the pressure differential across it.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure flow rate of liquid.

III. Course Level Learning Outcome (CO)

- CO4- Select relevant instrument for measuring the physical parameters of given system.

IV. Laboratory Learning Outcome(s)-

- Measure the Flow rate of liquid by rotameter.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background-

A rotameter is a tool used to gauge the liquid flow rate through a closed conduit. By adjusting the annular area, the variable area flow meter maintains a constant pressure drop at the intake and outflow. Since flow measurement is done from lower level to upper level, it is always positioned vertically.

VII. Experimental Setup-

Figure No.12.1- Rotameter

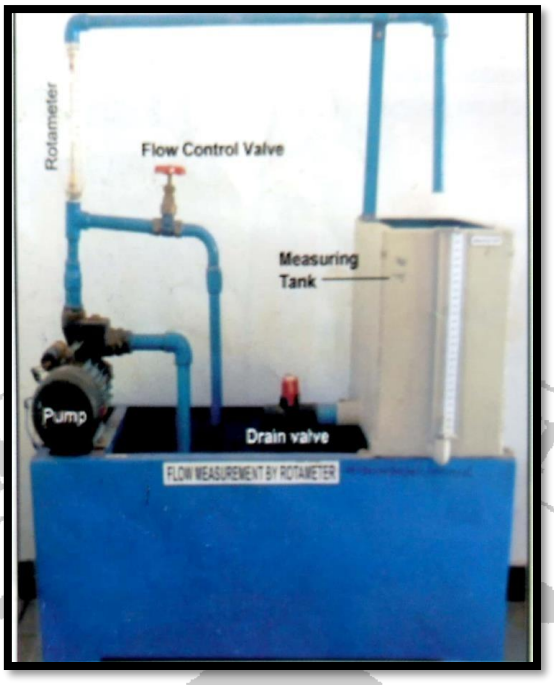


Figure No.12.2-Experimental Setup

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic Bench with Rotameter	Measuring Tank, Flow control Valve	1

IX. Precautions to be Followed

- Avoid improper handling of flow control valve

X. Procedure

1. Start the flow of water by opening the flow control valve
2. Float starts rising.
3. Rising and Falling action of float depends on rate of flow
4. Note down the readings.
5. Note down the flow in the Discharge tank

XI. Observations and Calculations

Sr. No	Rotameter Reading Lit/Min (LPM) (A)	Actual Flow in the discharge tank LPM (B)	Difference (LPM) (A - B)
1			
2			

Sr. No	Rotameter Reading Lit/Min (LPM) (A)	Actual Flow in the discharge tank LPM (B)	Difference (LPM) (A - B)
3			
4			

Discharge = **Q = V/t lit/min** - Where, V=Volume of filled tank, T=Time in sec.

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Classify flow measuring devices and give application of each.

2. List different materials of floats used in Rotameter.

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=b12XN3G4GaU
- https://www.youtube.com/watch?v=GNW44SBkW38

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 13 *Measurement of weight by using a load cell.

I. Practical Significance –

A load cell is a force transducer, by measuring force or weight through deflection. There are several varieties of load cells, including strain gauge, hydraulic, pneumatic, and mechanical versions.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure given weights

III. Course Level Learning Outcome (CO)

- CO5- Use relevant instrument for measuring operating parameters of given system

IV. Laboratory Learning Outcome(s)-

- Measure given weights by load cell.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background-

Load cell translate force into electrical signals, load cells are force transducers. Load cells are made consisting of a steel cylinder with four identical strain gauges installed on it. Strain gauges are extremely thin, heat-treated metallic foils that are chemically linked to a thin layer of elastic material. The Wheatstone bridge circuit's four limbs are linked to these four gauges.

VII. Experimental Setup-

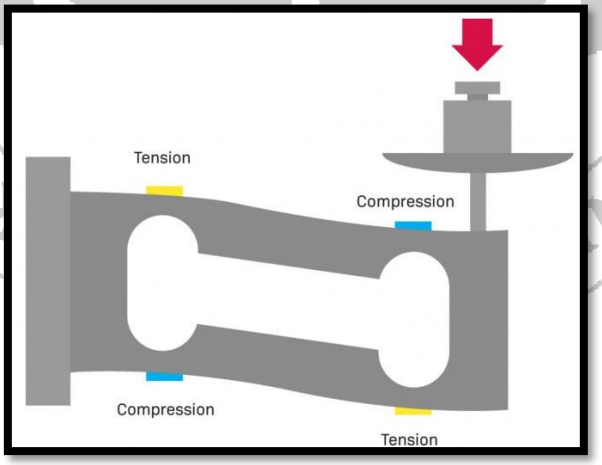


Figure13.1- Load Cell

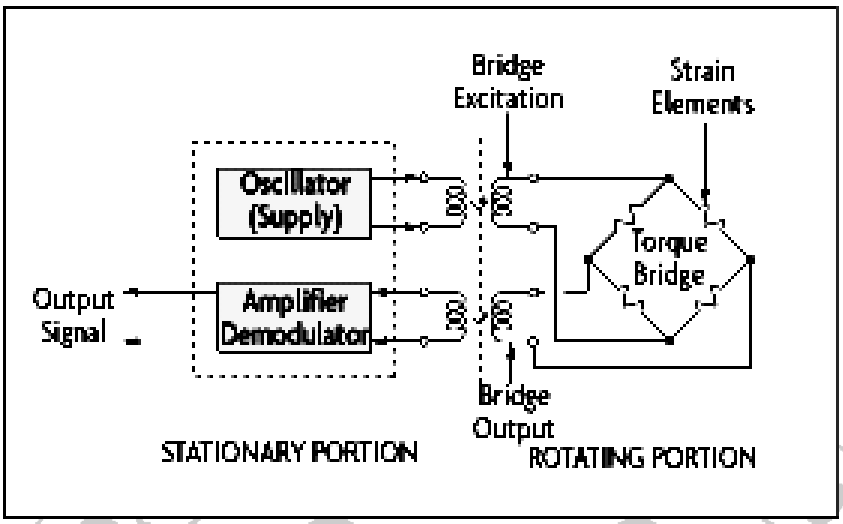


Figure.13.2-Experimental Setup

VIII. Resources Required.

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	4 arm bridge with strain gauge	Capacity Minimum 2Kg	1
2.	Dead weights	1Kg to 5kg	10
3.	Display	digital	1

IX. Precautions to be Followed

- Avoid improper handling of instrument

X. Procedure

a. Make connections to load cell
b. Switch 'ON' unit
c. Check initially the output in 'Zero'
d. Put dead weights on platform
e. Note readings
f. Increase load on load cell
g. Take five readings with specific load

XI. Observations and Calculations-

Sr. No.	Applied Load (kg) (A)	Output Load Cell readings (Kg) (B)	Difference (Kg) (A – B)
1			
2			

Sr. No.	Applied Load (kg) (A)	Output Load Cell readings (Kg) (B)	Difference (Kg) (A – B)
3			
4			
5			
6			

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List Different types of Load Cells with application.
2. Explain the constructional features of Load Cell

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=kWgzBpF67zk
- https://www.youtube.com/watch?v=sueBajVCIXw

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 14 Sound intensity measurements using Sound meter

I. Practical Significance –

Sound intensity measurement is a powerful technique that allows us to measure the flow of sound energy as a time-averaged vector quantity. The properties of sound intensity allow us to separate sound sources and to distinguish direct sound from reverberant sound in a room. The intensity of a sound is the power of the sound in Watts divided by the area the sound covers in square meters. The loudness of a sound relates the intensity of any given sound to the intensity at the threshold of hearing. It is measured in decibels (dB). Sound meter gives indication of machine failure by noise or sound measurement.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure sound level of system

III. Course Level Learning Outcome (CO)

- CO5- Use relevant instrument for measuring operating parameters of given system

IV. Laboratory Learning Outcome(s)-

- Measure Sound Level Using Sound meter.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background-

The microphone's diaphragm responds to variations in air pressure induced by sound waves. That is why the device is often known as a sound pressure level meter (SPL). The movement of the diaphragm, or sound pressure (Pa), is translated into an electrical signal (V).

VII. Experimental Setup-

Figure No.14.1- Sound Meter

VIII. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Sound level meter	Measuring capacity 30-130dB	1

IX. Precautions to be Followed

- Avoid improper handling of instrument

X. Procedure

1. Make Sure sound meter having cell/Battery
2. Switch 'ON' unit
3. Check sound level with sound wave direction.
4. Note readings
5. Take five readings with different systems.

XI. Observations and Calculations-

Sr No	Machine/System	Sound level in dB
1	Lathe machine	
2	Pump rotor	
3	Compressor	
4	Ceiling fan	
5	I C engine	

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List Different types of Microphones used in sound meter.
2. Write the sound limit as per API list.

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=xM8HhnvzRz8
- https://www.youtube.com/watch?v=OpR39D-IlvY

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No: 15 Measurement of the speed of the rotating shaft by stroboscope or inductive pick up.

I. Practical Significance –

An object's speed is proportional to its velocity. Speed can be quantified for either linear or circular movements. Stroboscopes use the phenomenon of vision, which occurs when an object is seen intermittently.

II. Industry/Employer Expected Outcome (s)

This practical is expected to develop the following skills for the industry/Employer

- Measure speed of rotating shaft.

III. Course Level Learning Outcome (CO)

- CO5-Use relevant instrument for measuring operating parameters of given system.

IV. Laboratory Learning Outcome(s)-

- Measure the speed of rotating shaft by stroboscope or inductive pick up.
- Use stroboscope or inductive pick up for measurement of speed of rotating shaft.

V. Relative Affective Domain Related Outcome(s)-

- Follow safety practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices Follow Ethical Practices.

VI. Minimum Theoretical Background-

Stroboscopes are made up of a rotating disk coupled to a motor whose speed may be adjusted and monitored. A reference mark on the revolving shaft is visible via an aperture in the rotating disk. The disc's motion is adjusted until the mark on the shaft appears to be stationary.

VII. Experimental Setup-

Figure No.15.1-Stroboscope

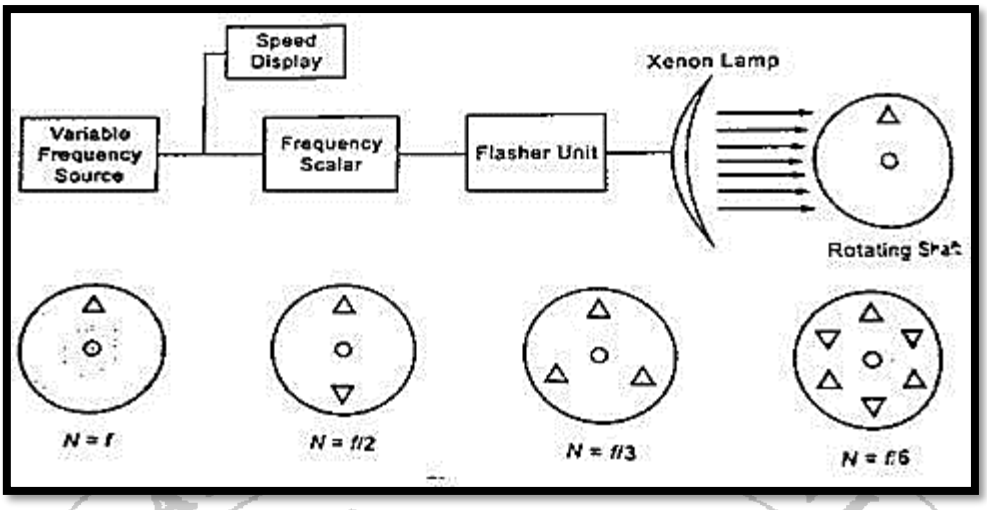


Figure No.15.2-Experimental setup of Stroboscope

VIII. Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Stroboscope	• Course and fine flash rate adjustments to freeze and analyze rotating objects. • Battery operation brings motion analysis to any location • Unique display features characters that reverse direction depending on measurement mode • Large 0.4" (10mm) 5 digit LCD display • Microprocessor based with quartz crystal oscillator to maintain high accuracy. • Tachometer memory stores last, max, and min readings	01
2.	Tachometer	Range 0 to 5000 RPM	01

IX. Precautions to be Followed

- Avoid improper handling of instrument
- Shaft rotating with high speed keep safe distance.

X. Procedure

1. Make a dark mark on the end section of rotating element.
2. Connect Stroboscope
3. Allow circular disc to attain constant speed by varying the rpm.
4. Switch ‘ON’ the stroboscope.

5. Flash frequency is gradually increased from Zero until the rotating member appears tobe stationary.
6. Note down the reading.
7. Note down reading of rotating member with help of Tachometer.
8. Take five different readings.

XI. Observations and Calculations

Sr. No	Actual Speed usingTachometer (rpm) (A)	Stroboscope Reading(rpm) (A)	Error (rpm) (A – B)
1			
2			
3			
4			
5			

XII. Results

XIII. Interpretation of Results

XIV. Conclusions and Recommendation

XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO

1. List non-contact type speed measuring devices & write their industrial applications.
2. Write Technical Specification of Stroboscope used in practical.

[Space for Answer]

XVI. References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=KPrSPqfVJhA

XVII. Rubrics for Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(60%)**
1	Handling of the measuring Instruments	20%
2	Taking reading of required parameters	20%
3	Calculation of final readings	20%
Product Related (10 Marks)		**(40%)**
4	Interpretation of result	10%
5	Conclusions	10%
6	Practical related questions	20%
	Total	**100 %**

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	