MANUFACTURING TECHNOLOGY – II
LABORATORY MANUAL

MECHANICAL ENGINEERING DEPARTMENT

(ISO 9001:2008 Certified)

MES COLLEGE OF ENGINEERING, KUTTIPPURAM

Manufacturing Technology –II Laboratory Manual

MECHANICAL ENGINEERING DEPARTMENT

Revision	Date	Prepared by			Approved by		
		Name	Designation	Signature	Name	Designation	Signature
Rev1.0					Dr.Rahmathunza. I	Prof. & HoD ME Dept.	

VISION

To develop the Department into a premier destination of international level for advanced learning in Mechanical Engineering and to mould quality engineers to serve the society through creative solutions.

MISSION

- To mould engineers who would be able to apply the basic science and mathematics with confidence in professional activities for the benefit of all.
- To make our graduates experts in practical problem solving with abstract thinking skills.
- To make our students life-long learners capable of building their careers upon a solid foundation of knowledge and competent in communicating technical materials and concepts in individual group situations

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

After 3-4 years of graduation, our students will be able to

- Demonstrate their skills in technical profession and/or higher education by using the acquired knowledge in Mathematics, Science and Engineering fundamentals.
- Analyze the real life problems and propose sustainable design solutions for specific needs through applications of Engineering principles.
- Recognize the ethical responsibility as engineers and judiciously serve their peers, employers & society for the benefit of all.
- Practice life-long learning by continuing up gradation of possessed skills.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of four year programme the students (graduates) will be able to:

- Demonstrate basic knowledge in mathematics, science and engineering.
- Design, manufacture and analyze a Mechanical system using modern engineering software tools and measurement systems.
- Cognize concepts involved in thermal and fluid energy systems.
- Utilize self education to develop lifelong learning to appraise and adapt global and societal contexts to propose Engineering solutions.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analy**sis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TABLE OF CONTENTS

Course Outcomes (CO's)

Course Outcomes (COs)

ME 331 MANUFACTURING TECHNOLOGY LAB II (C319)	
C319.1	Able to demonstrate programming practice on CNC machine tools
C319.2	Able to develop knowledge on the fundamental concepts and principles of metrology
C319.3	Able to explain the need of various modern measuring instruments and precision measurement techniques

1. CALIBRATION OF LOAD CELL

AIM

(a) To calibrate the Load Cell by plotting the graph between o/p voltage vs. load.
(b) To determine the static sensitivity and Impression of the Load Cell.

APPARATUS

1. Load Cell apparatus
2. A set of weights
3. A multimeter

SPECIFICATIONS

1. Maximum load – 5 kg
2. Exciting voltage – 10 V DC

DESCRIPTION OF THE APPARATUS

The experimental set up of the strain gauge load cell consists of a loading arrangement, D.C. exciting power supply, controls for adjusting exciting voltage, balancing the bridge and jacks for the measurement of bridge output.

PRINCIPLE

Four strain gauges forming a Wheatstone bridge circuit are bonded to a cantilever beam of the Load Cell. Since the strain gauge load cell is a passive transducer, an exciting voltage of 10 V is applied to the bridge. When no load is applied, the bridge is balanced and the bridge output voltage is zero. Load applied to the load cell produces compressive and tensile stresses in the cantilever beam. This causes strain in the gauges bonded to it and the bridge gets unbalanced. The resulting bridge output is a measure of the load applied to the load cell.

PRECAUTIONS

1. The bridge must be in balanced condition under no load.
2. The exciting voltage should not exceed 10 V.

PROCEDURE

An exciting voltage (10 V) was applied to the Wheatstone bridge circuit. The bridge was brought to balanced position by rotating the bridge offset knob. The loads were added in steps to the maximum load and at each step the bridge output voltage is noted down. Then the loads were reduced to zero in steps and at each step the bridge output voltage is noted down. The values were tabulated. Average of these two is used as output quantity (q_o) in the calculations. To calibrate the load cell a graph is plotted between o/p voltage (milli volts) and load (kg).

CALCULATIONS:

(a) Static sensitivity = $\Delta q_o / \Delta q_i$ (from graph)

Where Δq_o = increment in o/p voltage (mV)
Δq_i = corresponding increment in load (kilograms)

a) Standard deviation, σ

$$\sigma = \sqrt{1/N \sum \left[\left(q_o - b\right)/m - (q_i)\right]^2} \quad \text{kg}$$

Where, q_o = Output voltage

b = Intercept

m = Slope

N = Number of observations

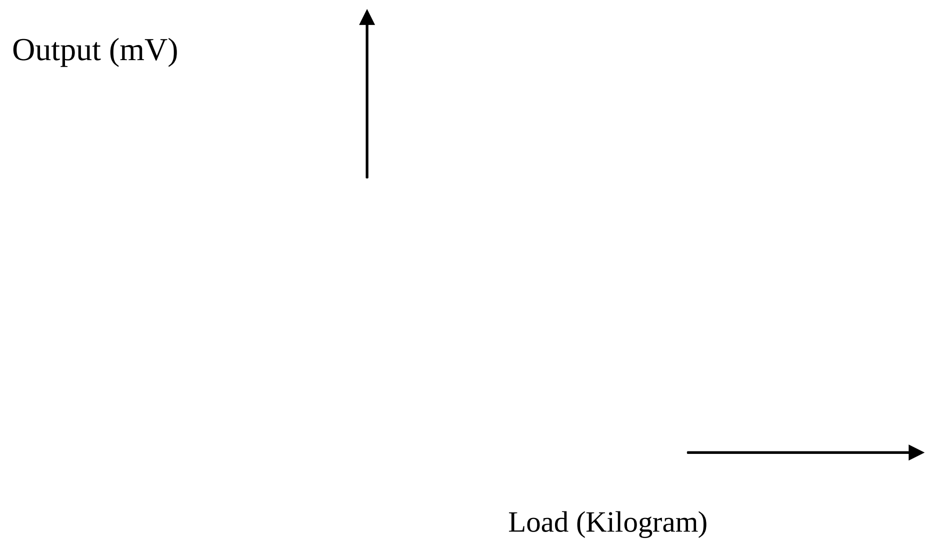
$$m = \frac{N\sum q_i q_o - \sum q_i q_o}{N\sum q_i^2 - (\sum q_i)^2} \qquad b = \frac{\sum q_o \sum q_i^2 - \sum q_i q_o \sum q_i}{N\sum q_i^2 - (\sum q_i)^2}$$

b) Imprecision of the instrument = $\pm 3\sigma$ kg

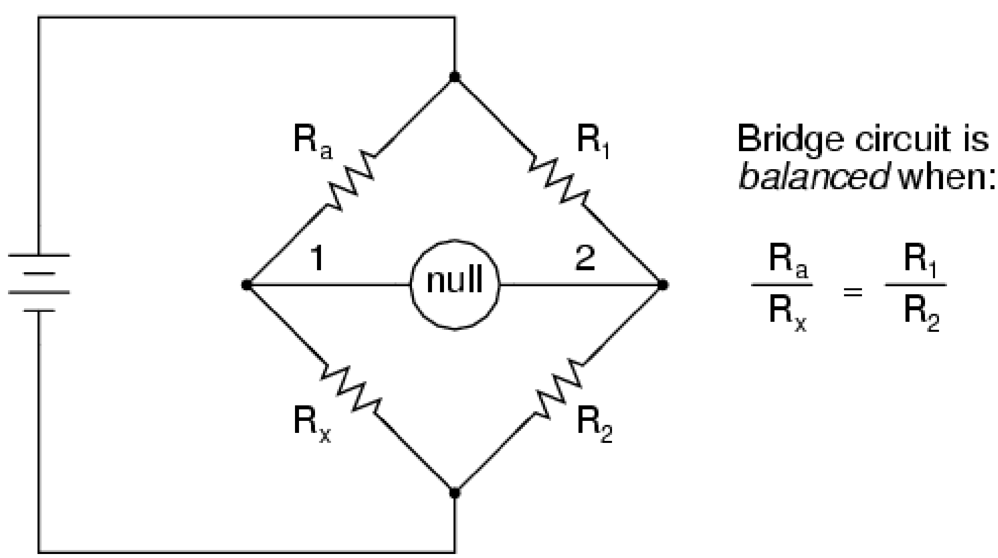
OBSERVATIONS

Sl. No.	Input (q_i) kilograms	Output (q_o) (mV)			qi x q_o	qi^2	$\frac{q_o - b}{m}$	$[(q_o – b/m) – (q_i)]^2$	Sensitivity $\Delta q_o/\Delta q_i$ (mV/kg)
		q_1	q_2	q_0					
1	1								
2	2								
3	3								
4	4								
5	5								

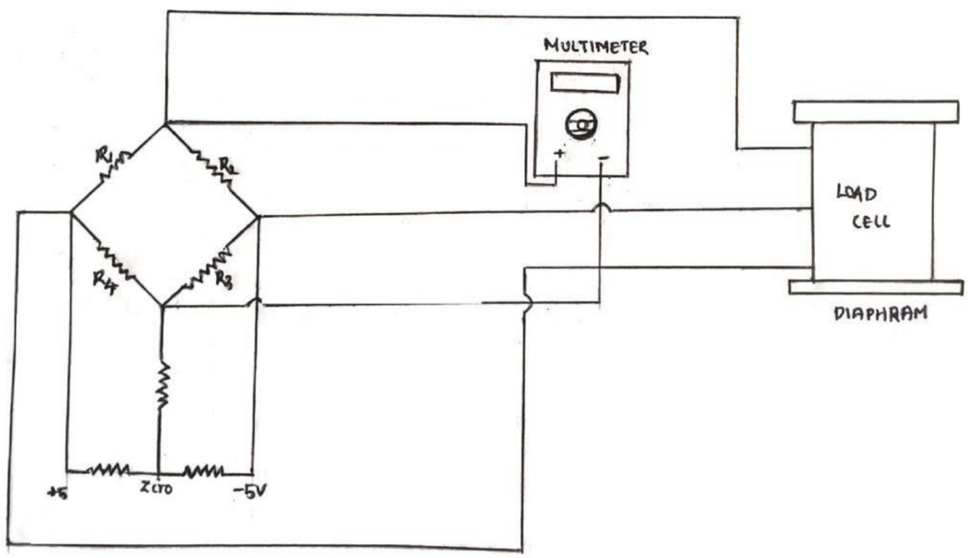
EXPECTED GRAPH



WheatStone Bridge Circuit



Schematic Diagram for Calibration set up of Load Cell



RESULT & INFERENCE

The given load cell is calibrated and the load v/s output voltage graph is plotted

1. Sensitivity from calculations (m) = -------------------------- mV/kg
2. Sensitivity from graph = -------------------------- mV/kg
3. Imprecision = -------------------------- kg

2.CALIBRATION OF LINEAR VARIABLE DIFFERENTIAL TRANSFORMER [LVDT]

AIM

To calibrate the given LVDT.

APPARATUS

1. LVDT
2. Multimeter

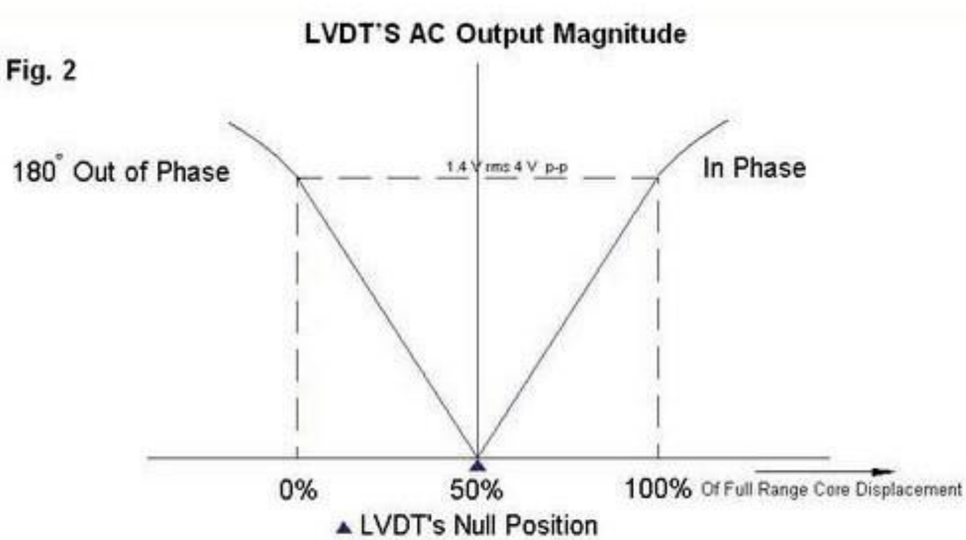
PRINCIPLE

LVDT is a variable reluctance type displacement transducer, where a moving coil is used to vary the magnetic flux coupling the two coils. It consists of a primary winding, two secondary windings and a movable core. When the core is in the null position, the voltage in the two secondaries will be equal and the output voltage will be zero.

LVDT is constructed with an iron core with a non magnetic rod moving freely inside the windings. The iron core is responsible for the flux linkage.

With the two identical secondary coils, sinusoidal voltages of same frequency are produced the amplitude varies with the position of the iron core when the secondary coils are connected. In series opposition null output is obtained at the null position motion of the core from the null position causes a large mutual inductance for one coil and a small mutual inductance for another coil and the amplitude of the output voltage becomes a linear function of the core position.

Fig. 2



AC Output of Conventional LVDT Versus Core Displacement

PROCEDURE

1. The power supply of the LVDT module is switched ON.
2. The LVDT is placed at the null position (12.5mm) and the offset is adjusted to read zero on the DVM calibrated in terms of the displacement of the core.
3. The core is gradually moved to the +ve direction (25mm) and gain is adjusted
4. The above steps are repeated in the opposite direction. Corresponding millivolt readings are taken.
5. To calibrate the LVDT, a graph is plotted taking displacement along X- axis and voltage along Y- axis.

OBSERVATIONS

POSITIVE DISPLACEMENT

Sl. No.	Displacement q_i (mm)	Voltage, q_o (mV)	q_i x q_o mV mm	q_i^2 mm^2	$\frac{qo - b}{m}$	$[\frac{\square\square-\square}{\square} - q\square]^2$	Sensitivity mV/mm

NEGATIVE DISPLACEMENT

Sl. No.	Displacement q_i (mm)	Voltage, q_o (mV)	q_i x q_o mv mm	q_i^2 mm^2	$\frac{qo - b}{m}$	$[\frac{□□-□}{□} - q□]^2$	Sensitivity mV/mm

The calculations involved are:

(b) Static sensitivity = $\Delta q_{□} / \Delta q_{□}$ (from graph)

Where $\Delta q_{□}$= increment in o/p voltage (mV)

$\Delta q_{□}$ = corresponding increment in load (mm)

c) Standard deviation, □

$$□ = \sqrt{1/N\sum \quad [(q_{□} - \frac{□}{□}) - (q_{□})]^2} \quad \text{mm}$$

Where, q_o = Output voltage

b = Intercept

m = Slope

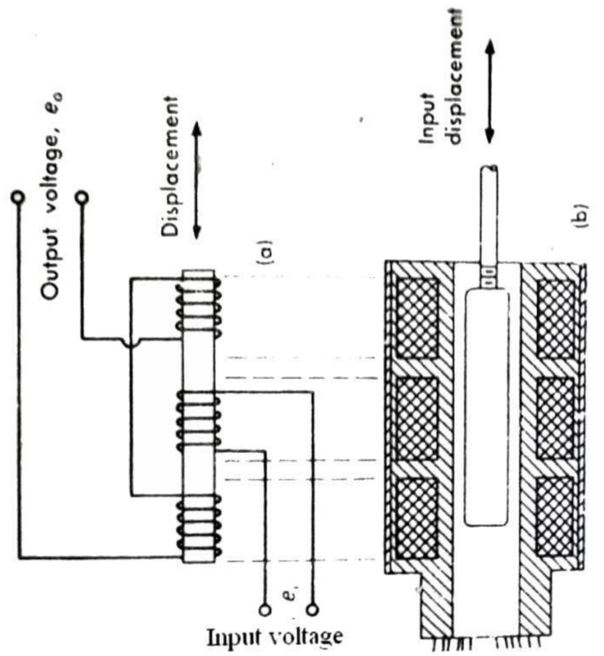
N = Number of observations

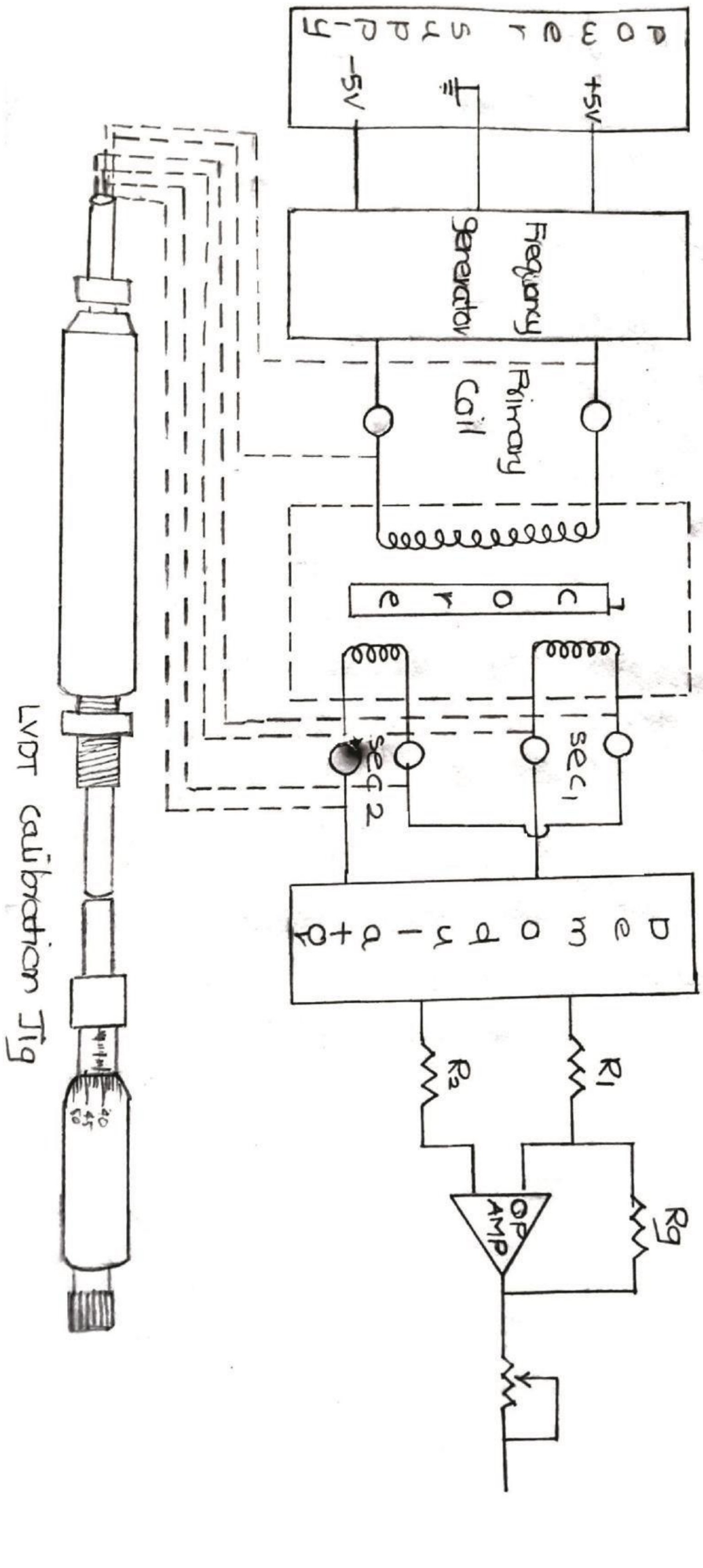
$m = \frac{N\sum q_{□} q_{□} - \sum q_{□} q_{□}}{}$ b = $\frac{\sum q_{□} \sum q_{□}^2 - \sum q_{□} q_{□} \sum q_{□}}{}$

$N\sum q_{\square}^{2}-(\sum q_{\square})^{2}$ $N\sum q_{\square}^{2}-(\sum q_{\square})^{2}$

d) Imprecision of the instrument = ±3□ mm

SCHEMATIC DIAGRAM OF LVDT




power supply
-5V
+5V
Frequency Generator
Primary Coil
core
sec1
sec2
Demodulator
R1
R2
Rg
OP AMP
LVDT Calibration Jig

RESULT

Positive displacement

a) Sensitivity from observation =
b) Sensitivity from graph =
c) Imprecision =

Positive displacement

a) Sensitivity from observation =
b) Sensitivity from graph =
c) Standard deviation =
d) Imprecision =

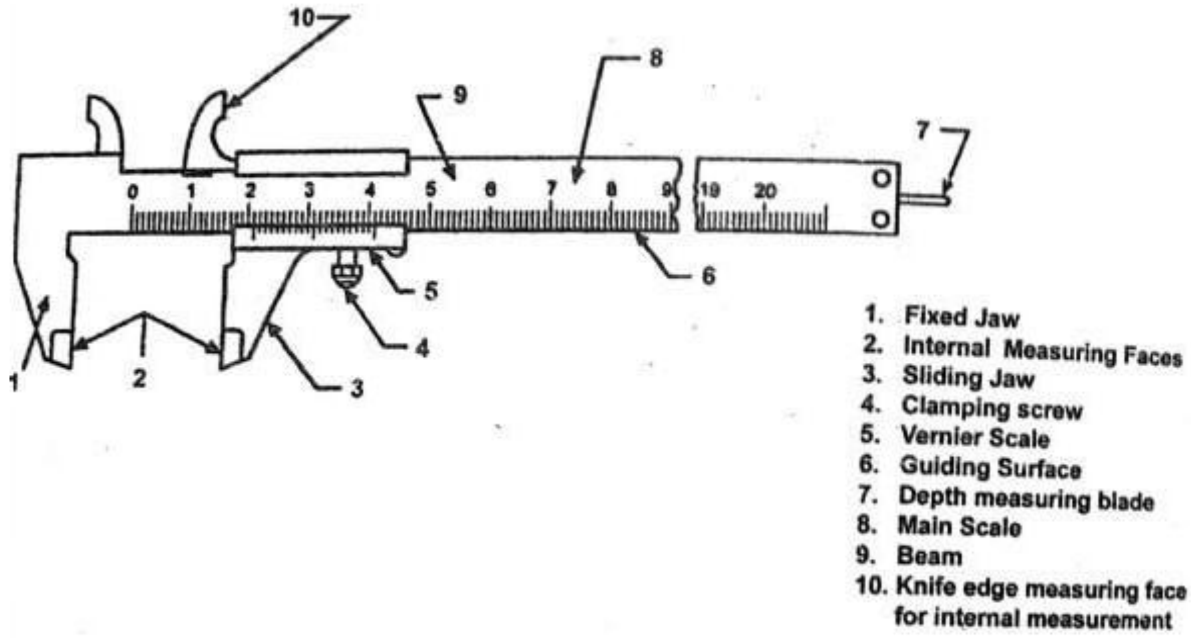
3. EXERCISES ON VERNIER TYPE MEASURING TOOLS

Objectives:-

1. To study the working principle of various vernier type measuring instruments.
2. To measure the dimensions of the given specimen and to prepare the drawings.

3.1 VERNIER CALIPER:

Vernier caliper consists of two scales, namely, main scale and vernier scale. Main scale is a fixed scale and vernier scale is movable. When the fixed jaw of the main scale and sliding jaw of the vernier scale is closed, the zero on the vernier scale coincides with zero on the main scale.



Least Count:

Least count is the minimum distance, which can be measured with the instrument. It is the difference between one main scale division and one vernier scale division

Precautions:

(i) ***Abbes's law:*** The line of measurement of the measuring component should coincide with the measuring scale or axis of the measuring instrument.

(ii) ***Parallax error:*** Align the line of sight perpendicular to the scale during measurement.

(iii) ***Outside measurement:*** Put the work piece as close to the reference surface as possible and make the measuring surfaces perfectly in contact with the work piece.

(iv) ***Inside measurement:*** Put the inside jaws as deep as possible and make the measuring surfaces perfectly in contact with the work piece.

(v) ***Depth measurement:*** Set the depth gauge perpendicular to the bottom of the work piece.

(vi) Do not apply the vernier caliper on rotating work piece. This is dangerous and the measuring surfaces may wear out.

Procedure:

- Note the least count of the instrument
- Check the instrument for zero error
- Place the specimen in between the jobs
- Move the sliding jaw towards the specimen and hold it tight
- Note the main scale reading (M.S.R) and vernier scale reading (V.S.R)
- Actual reading = [(M.S.R+ (V.S.R x L.C)]
- Repeat the process and find out the average value

Results & Inference:

SPECIFICATIONS:

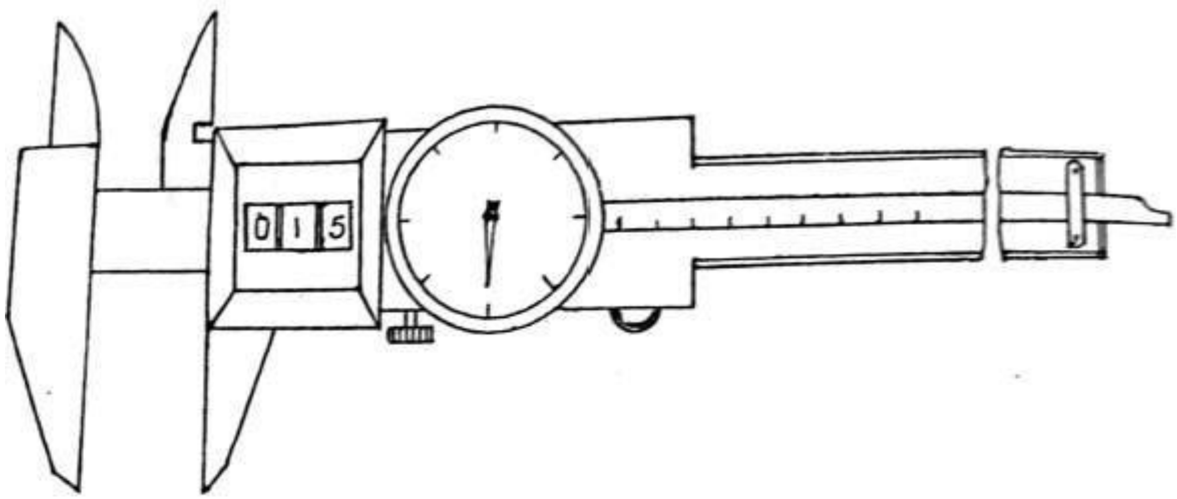
Vernier Caliper Range:
Least Count :
Zero Correction :

OBSERVATIONS

Element	Trial No.	Main Scale Reading (M.S.R)	Vernier Scale Reading (V.S.R)	Actual Reading [(M.S.R+ (V.S.R x L.C)]	Mean
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				

3.2 DIGIT DIAL VERNIER

This type of instrument can be used for inside and outside measurements. It has a digit dial system. The specimen is kept between the jaws and the reading is taken from the digit dial and the circular scale.



Results & Inference:

SPECIFICATIONS

Range :

Least count :

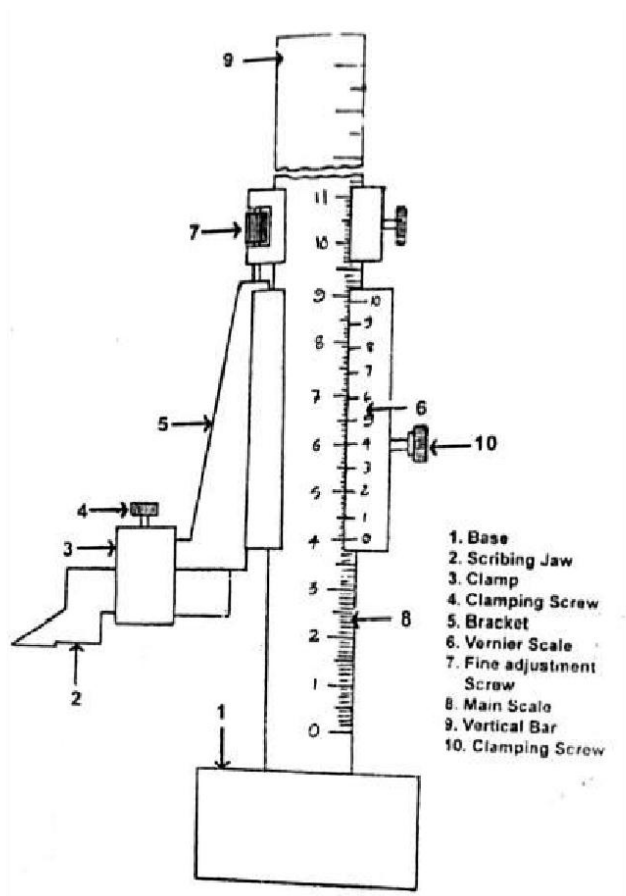
OBSERVATIONS

Element	Trial No.	Digit Dial Reading (X)	Circular Scale Reading (Y)	Actual Reading [X + Y]	Mean
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				

3.3 VERNIER HEIGHT GAUGE

The vernier height gauge is designed for measuring heights and for layout jobs. It is held in vertical position and is used in conjunction with a surface plate. It consists of

i. A finely ground and lapped base. The base is massive and robust to ensure rigidity and stability
ii. Vertical graduated beam
iii. A sliding vernier head carrying a vernier scale and a clamping screw
iv. An auxiliary head with fine adjustment and clamping screw
v. A measuring jaw / scriber attached to the sliding vernier



PROCEDURE

- Note the least count
- Check the vernier Height Gauge in zero position
- Bring the scribing jaw down to base against the surface plate. The zero mark on the vernier and beam should coincide
- In Height measurement hold the base down the surface plate and with the left hand and turning the fine adjustments nut with the right hand bring the measuring jaw in contact with the surface
- When laying out, first set the gauge to size and then slightly pressing the base against the surface plate move the gauge with the scriber along the work.

RESULTS AND INFERENCE

SPECIFICATIONS

Range :

Least Count (L.C) :

Zero Error :

OBSERVATIONS

Element	Trial No.	Main Scale Reading (M.S.R)	Vernier Scale Reading (V.S.R)	Actual Reading [M.S.R + (V.S.R x L.C)]	Mean
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				

4. TOOL MAKER'S MICROSCOPE

Objectives:-

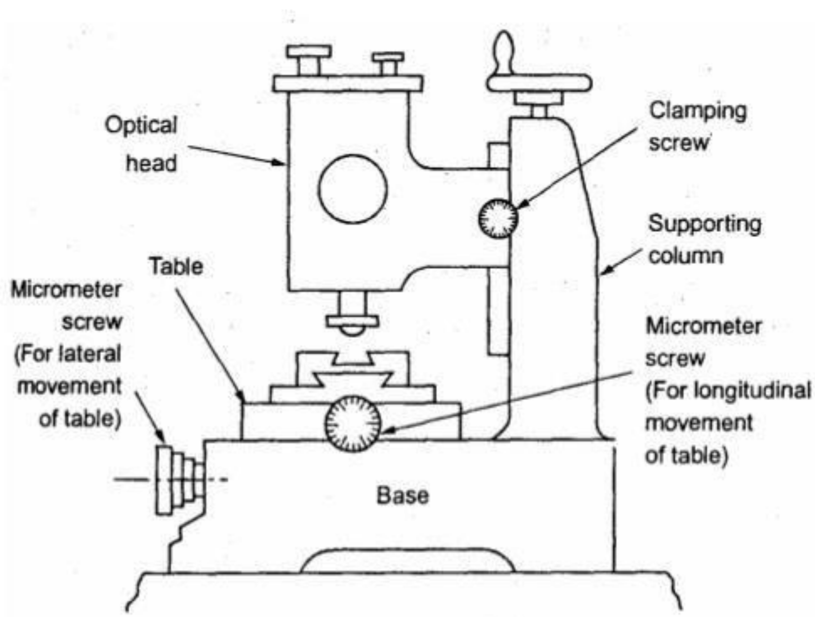
3. To study the working principle of tool maker's microscope
4. To measure the dimensions of the given specimen and to prepare the drawings.

Principle:

Tool maker's microscope is a versatile instrument that measures the variation by optical means, with no pressure being involved. It is a very useful instrument for making measurements on small and delicate parts.

It is designed for the following measurements:

i. Measurements of parts of complex form;
ii. The profile of external threads as well as tools;
iii. Measuring centre to centre distance of holes in any plane;
iv. Accurate angle measurement;
v. Determining the relative positions of various points on work.



Procedure:

- Switch on the main
- Switch on the microscope lights
- Select the capacity of the lens for precise operation
- Place the object on the glass table and in order to get a clear image rotate the wheel provide at the light side
- After getting the clear image, locate the cross wire at the initial point on the image. Note down the micrometer reading
- Move the cross wire from the initial point to the final point on the image, which is to be measured. Note down the micrometer reading
- Now, the difference between the initial and final reading i.e., the distance travelled gives the size of the object.
- Angular measurements can also be read, following the same procedure, except that, the angle between the initial and final positions is to be read out.

Results & Inference:

SPECIFICATIONS:

Magnification :

OBSERVATIONS

Specimen	Parameter	Initial Reading	Final Reading	Difference	Size of object

5. EXERCISES ON CNC LATHE

5.1 SIMPLE FACING

AIM:

To prepare a part program and simulate a facing operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLTURN

Controller: FANUC

Software used: NOVATURN CNC simulation package.

Billet size: 22 x 60

Tool holder: SDJCR1212H11

Tool Tip: DCMT11T304

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X22 Z60
G21 G98
G28 U0 W0
M06 T0303
M03S1200

G00 X22 Z1
G01 Z-5 F45
G01 X0
G01 Z1

G00 X22
GO1 Z-1.5
G01 X0
G01 Z1

G00 X22
G28 U0 W0
M05
M30
```

5. Check the program for Syntax error and correct if any.

6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Lathe.

5.2 SIMPLE TURNING

AIM:

To prepare a part program and simulate a turning operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLTURN

Controller: FANUC

Software used: NOVATURN CNC simulation package.

Billet size: 22 x 60

Tool holder: SDJCR1212H11

Tool Tip: DCMT11T304

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X22 Z60

G21 G98
G28 U0 W0
M06 T0303
M03S1200
G00 X22 Z1

G01 X 21
G01 Z-30 F45
G00 X22
G00 Z1
G01 X21
G01 Z-30 F45
```

G00 X22
G00 Z1
G01 X20
G01 Z-30 F45
G00 X22
G00 Z1
G01 X19
G01 Z-30 F45
G00 X22
G00 Z1
G01 X18
G01 Z-30 F45

G00 X22
G00 Z1
G01 X17
G01 Z-30 F45
G00 X22
G00 Z1
G01 X16
G01 Z-30 F45
G00 X22
G00 Z1
G01 X15
G01 Z-30 F45
G00 X22
G00 Z1
G01 X14
G01 Z-30 F45
G00 X22
G00 Z1
G28 U0 W0
M05
M30

5. Check the program for Syntax error and correct if any.
6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Lathe.

5.3 TAPER FACING

AIM:

To prepare a part program and simulate a facing operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLTURN

Controller: FANUC

Software used: NOVATURN CNC simulation package.

Billet size: 22 x 60

Tool holder: SDJCR1212H11

Tool Tip: DCMT11T304

PROCEDURE:

9. Switch on the computer and run the software.
10. Analyze the drawing required to be machined.
11. Select the billet and tool required for the operation
12. Prepare the part program

[BILLET X22 Z60

G21 G98
G28 U0 W0
M06 T0303
M03S1200
G00 X22 Z1
G94 X10 Z-.5 F35
Z-1
Z-1.5
Z-2
Z-2.5
Z-3
Z-3.5
Z-4
Z-4.5
Z-5
Z-5.5
Z-6
Z-6.5
Z-7
Z-7.5
Z-8

Z-8.5
Z-9
Z-9.5
Z-10
G28 U0 W0
M06 T0101

M03 S1000
G00 X22 Z-10
G94 X22 Z-25 R-10 F30
X21
X20
X19
X18
X17
X16
X15
X14
X13
X12
X11
X10
G28 U0 W0
M05
M30

13. Check the program for Syntax error and correct if any.
14. Save the file and execute the program.
15. Simulate the program and check the 3D view.
16. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Lathe.

5.4 MULTIPLE FACING

AIM:

To prepare a part program and simulate a facing operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLTURN

Controller: FANUC

Software used: NOVATURN CNC simulation package.

Billet size: 30 x 60

Tool holder: SDJCR1212H11

Tool Tip: DCMT11T304

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X30 Z60

G21 G98
G28 U0 W0
M06 T0303

M03S1200
G00 X31 Z1

G72 W0.5 R0.5
G72 P10 Q20 U0.1 W0.1 F35
N10 G01 Z-52
X30
Z-47
X25 Z-42
Z-37
G02 X20 Z-30 R10 F25
G01 Z-25
G03 X10 Z-15 R10
G01 Z-10 F35
N20 X5 Z0
G28 U0 W0
M06 T0202
```

M03 S1450
G00 X31 Z1
G70 P10 Q20 F25

G28 U0 W0
M05
M30

5. Check the program for Syntax error and correct if any.
6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Lathe.

5.5 MULTIPLE TURNING

AIM:

To prepare a part program and simulate a facing operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLTURN

Controller: FANUC

Software used: NOVATURN CNC simulation package.

Billet size: 32 x 60

Tool holder: SDJCR1212H11

Tool Tip: DCMT11T304

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X32 Z60

G21 G98
G28 U0 W0
M06 T0303

M03S1200
G00 X32 Z1

G71 U.5 R1
G71 P10 Q20 U.1 W.1 F35
N10 G01 X5
G01 Z0
G01 X10 Z-10
G01 Z-15
G02 X20 Z-25 R10
G01 Z-30
G03 X25 Z-37 R10
G01 Z-42
X30 Z-47
N20 Z-52
G28 U0 W0
M06 T0202
M03 S1450
```

G00 X32 Z1
G70 P10 Q20 F25

G28 U0 W0
M05
M30

5. Check the program for Syntax error and correct if any.
6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Lathe.

6. EXERCISES ON CNC MILLING MACHINE

6.1 MILLING OPERATION-1

AIM:

To prepare a part program and simulate a milling operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLMILL

Controller: FANUC

Software used: NOVAMILL CNC simulation package.

Billet size: 100X100X10

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X100 Y100 Z10
[EDGEMOVE X0 Y0

[TOOLDEF T1 D5
G21 G94

G91 G28 Z0

G28 X0 Y0
M06 T1
M03 S2000
G90 G00 X10 Y10 Z5
G00 Z0
M98 P0014000
M98 P0014000
M98 P0014000
M98 P0014000
M98 P0014000
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30
```

```
O4000
M98 P0014000
G01 X10 Y73 F50
X66
Y61
G03 X83 Y44 R13
G01 X10 Y73 F50
X66
Y61
G03 X83 Y44 R13
G01 X83 Y29
G02 X65 Y10 R20
G01 X10 Y10
M99
O4001
G91 G01 Z-0.5 F50
G90
M99
```

5. Check the program for Syntax error and correct if any.
6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Milling machine.

6.2 MILLING OPERATION-2

AIM:

To prepare a part program and simulate a milling operation on the billet to the required dimension.

Machine used: MT LAB DENFORD

Model: XLMILL

Controller: FANUC

Software used: NOVAMILL CNC simulation package.

Billet size: 100X100X10

PROCEDURE:

1. Switch on the computer and run the software.
2. Analyze the drawing required to be machined.
3. Select the billet and tool required for the operation
4. Prepare the part program

```
[BILLET X100 Y100 Z10
[EDGEMOVE X-50 Y-50

[TOOLDEF T1 D6
G21 G94

G91 G28 Z0

G28 X0 Y0
M06 T1
M03 S2000
G90 G00 X10 Y-37.5 Z5
G01 Z-1 F50

G01 X-22.5 Y-37.5
G03 X-37 Y-22.5 R15
G01 X-37.5
G01 X-37.5 Y22.5
G03 X-22.5 Y37.5 R15
G01 X-22.5 Y-37.5
G02 X37.5 Y22.5 R15
G01 X37.5 Y-22.5
G03 X22.5 Y-37.5 R15
G01 X0 Y-37.5
G00 Z5
G00 X-15 Y0
G01 Z-1 F50
```

```
G02 X15 Y0 R15
G02 X-15 Y0 R15
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30
```

5. Check the program for Syntax error and correct if any.
6. Save the file and execute the program.
7. Simulate the program and check the 3D view.
8. Exit from the software and turn off the system.

RESULT:

Prepared the part program and simulated the program on MTLAB-DENFORD CNC Milling machine.

7.ACCEPTANCE TEST ON MILLING MACHINE

Aim

To conduct an acceptance test on milling machine

Tools

Dial indicate, angle plate, spindle level, straight edge.

(1) Flatness at work table:

A spirit level is placed directly on the milling machine table at various points and readings are taken.

(2) Parallelism of the clamping surface of work table:

A dial gauge is fixed on the spindle. The dial gauge spindle is attached to touch the table square. The table is then moved in longitudinal direction and readings are noted.

(3) Parallelism of transverse movement of the work table to the main spindle:

A dial gauge is fixed to spindle. The dial gauge spindle is adjusted to touch the table surface. The table is then moved in transverse direction and readings are taken.

(4) Parallelism of center slot with a longitudinal movement:

The dial gauge is fixed to the spindle and adjusted so that the feeler touches the inner edge of the T- slot. The table is then moved longitudinally and the dial gauge readings are noted.

(5) Squareness of the table surface with column face:

The dial gauge is fixed on the column face with its taking the table surface. Then the dial gauge is set to zero position. The table is then raised and the deflection of the dial gauge is noted.

(6) Squareness of table surface with V- guide ways of the column:

The dial gauge is fixed on the table surface its feeler is made to touch with the V- guide ways of the column. Then the dial gauge is set to zero position. The table is raised and deflection is noted.

(7) Parallelism of over arm guide ways with the axis of the main spindler:

Vertical plane, Horizontal plane.

The overhanging arm is clamped in its extreme extruded position. The dial gauge is fixed to the arbor support. The feeler of the dial gauge is adjusted to touch the top of the test ….. The arbor Support can then be moved along the overhanging arm and deviations from parallelism observed on the dial gauge.

Results

Inference

8.ACCEPTANCE TEST ON LATHE

Aim

To conduct an acceptance test as the given lathe.

Equipments

Spirit level, dial indicator, mandeel etc.

(1) Bed straightness:

The spirit level is placed on the bed ways on the front position, back position and in the cross-wise direction. The position of bubble in the spirit level is checked and readings are noted.

(2) Tail stock guide ways parallel with movement of carriage:

The dial indicator is fixed on the carriage and the feeler is made in contact with the gide ways. The dial gauge is then set to zero. Then the carriage is moved from one end to another and readings are noted.

(3) Work spindle:

The work spindle is rotated with the feeler of dial gauge which is in contact with it. Then the readings are taken.

(4) Top of work spindle run out:

The test mandeel is held with its taper shank in the head stock spindle socket. The dial gauge is mounted on the saddle with its spindle touching the mandeel. Then the saddle is moved longitudinally along the bed ways and readings are taken.

(5) Carriage moves of upper slide parallel to the work spindle in vertical:

For testing attest mandeel is fitted in to the headstock spindle. The dial indicator is fixed at the carriage and the feeler is made in contact with mandeel in vertical position and the zero is set.

(6) Tail stock:

The dial gauge is set on the carriage with its feeler touching the tail stock at one end. Then the carriage is moved along the bed from one end to another and the deflection is noted.

(7) Axis of center:

A mandeel is placed between the head stock and tail stock and a dial gauge is fitted on the carriage with its feeler touching the mandeel. Then the carriage is moved from one end to another and the deflection is noted.

Result

Inference

9.ACCEPTANCE TEST ON SHAPER

Aim

To conduct an acceptance test on given shaper.

Equipments

Dial gauge with least count 0.01mm, spirit level.

(1) Flatness of the top fixing surface of the table:

The table is brought in the central position. The spirit level is placed at several parts on the table parallel to and perpendicular to the direction of the table feed.

(2) Parallelism of the top fixing surface of the table to the transverse movement:

The table is brought to one side end. Dial gauge on the ram, straight edge is placed on the table top. The table top is then moved in transverse direction below the dial gauge and readings are taken.

(3) Parallelism of table top to ram movement:

The ram is brought to end of its edge. The dial gauge is placed on the table top in the direction of movement of ram. The ram is then moved backwards and forwards and readings are taken.

(4) Parallelism of the side of the table to the movement of ram:

The ram is brought to the end of its side edge. The dial gauge is placed on the side of the table and ram is moved backwards and forwards and readings are taken.

(5) Parallelism of the guide for the table support to transverse movement of the table:

The table is brought to one side end. Dial gauge is fixed on the guide for table support. The table is then moved in transverse direction and readings are taken.

(6) Parallelism of the fixing slot in the top fixing surface of the table to the ram movement:

The angle plate is inserted in the slot length wise and the dial gauge is set in the adjacent parallel slots. The dial gauge is then so adjusted that its feeler joint touches the angle plate. The readings are adjusted to zero and then the dial indicator is moved through the slot length wise and deflection is noted.

(7) Perpendicularity of the fixing surface of the top table:

The angle plate is inserted in the slot length wise and dial gauge feeler is made to touch the angle plate. The reading is then adjusted to zero and then the dial indicator is moved in a perpendicular direction and the deflection is noted.

Result

Inference

10.GRINDING OF TOOLANGLES OF A SINGLE POINT LATHE TOOL AND ITS MEASUREMENT USING TMM

AIM

The primary objective of this experiment is to grind the single point cutting tool with the given nomenclature and measure angles using tool maker's microscope.

APPARATUS AND MATERIALS REQUIRED

1. Tool and cutter grinder
2. Tool maker's microscope
3. Universal vice
4. HSS tool blank

THEORY

The tool bit is usually made of high-speed steel. Correct grinding of the lathe tool cutter bit is essential for good lathe work, because a properly ground cutter bit will produce better results, will last longer, and will cut more readily than a tool bit which has been improperly ground. Correct grinding of the lathe tool cuter bit involves grinding the correct angles on the tool bit for the turning job that is to be done, and for the material that is to be turned.

Fig:1 Basic features of single point cutting tool

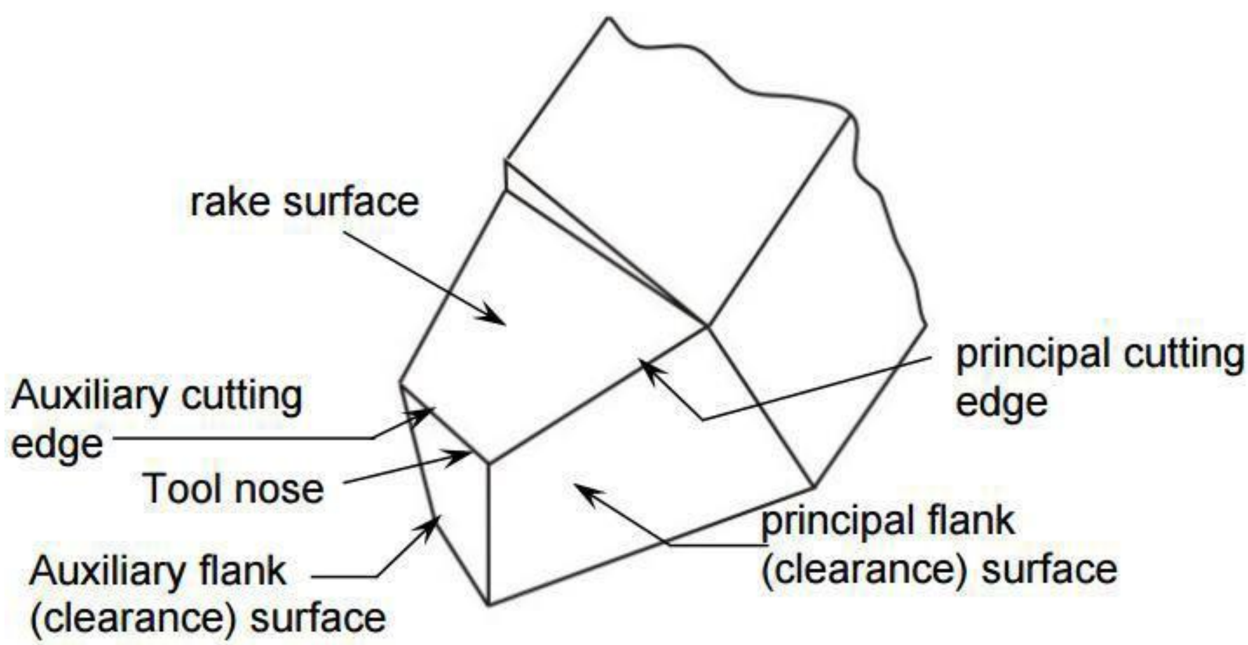


Fig:1 Basic features of single point cutting tool

Face or rake surface: which is the surface of cutting tool along which the chips move.

Flank surface: the surface which face the work piece. There are two flank surfaces, namely principal and auxiliary flank surfaces.

Cutting edge: edge which removes material from the work piece. There are two cutting edges. The principal cutting edge performs the function of major material removal and is formed by the intersection line of rake face with the principal flank surface. The auxiliary cutting edge, often called as end cutting edge, is formed by intersection of rake face with the auxiliary flank surface.

Corner or cutting point: The meeting point of principal and auxiliary cutting edges. Often a nose radius is provided to avoid a sharp corner.

SIGNIFICANCE OF TOOL ANGLES

Rake angle: Angle of inclination of rake surface from reference plane

The rake angle has the following function:

1. It allows the chip to flow in convenient direction
2. It reduces the cutting force required to shear the metal and consequently helps to increase the tool life and reduce the power consumption. It provides keenness to the cutting edge.
3. It improves surface finish

Clearance angle: Angle of inclination of clearance or flank surface from the finished surface. It reduces rubbing action between the tool and the work piece.

Side cutting edge angle: The angle between side cutting edge and the side of the tool shank. It is often referred to as the lead angle.

The following are the advantages of increasing this angle,

1. It increases tool life as, for the same depth of cut; the cutting force is distributed on a wider surface
2. It diminishes the chip thickness for the same amount of feed and permits greater cutting speed.
3. It dissipates heat quickly for having wider cutting edge.

End Cutting Edge Angle: The angle between the end cutting edge and a line perpendicular to the shank of the tool shank is called end cutting edge angle.

The function of end cutting edge angle is to prevent the trailing front cutting edge of the tool from rubbing against the work. A large end cutting edge angle unnecessarily weakens the tool.

PROCEDURE

1. Mount the tool vertically on the universal vice.

2. Set all the axis of the fixture to zero.

3. To grind the principal flank of a single point turning tool, set the required angles in the vice by rotating its two arms, so that the normal is brought at right angle to the grinding face of the wheel. The face to be ground is shown in following figure.

4. Start the grinding operation by providing small depth of cut and feed.

5. Repeat the procedure for grinding various angles such as end cutting edge angle and end relief angle.

6. By moving the arms, bring it back to its original position and remove the tool from the vice.

7. Align the axis of the tool in the horizontal position.

8. Rotate the fixture through back rake angle and side rake angle, so as to obtain the rake face parallel to the grinding wheel. Required face is shown in figure.

9. Un mount the tool from the vice.

10. Side cutting edge angle, end cutting edge angle and end relief angle can be directly measured by using tool maker's microscope.

11. Back rake, side rake and side relief angles are measured using dial gauge and fixtures used for aligning the tool in the required direction.

OBSERVATION TABLE

SI No	Tool angle names	Initial reading	Final reading	Difference (x)	Given value(y)	Error (x-y)
1	Bake rake angle					
2	Side rake angle					
3	End relief angle					
4	Side relief angle					
5	End cutting edge angle					
6	Side cutting edge angle					

PRECAUTIONS

1. Small amount of feed should be given so as to avoid breakage of tool and damage to grinding wheel.

2. As vice is heavy, care should be taken while handling it.

3. Keep away from the grinding zone to avoid spark injury.

RESULT:

The single point cutting tool is thus made with the given nomenclature and measure angles using tool maker’s microscope.

11. MICROMETERS

AIM

To study the working principle and parts of various micrometers
To measure the dimensions of given specimen and to prepare the drawings

EXTERNAL MICROMETERS

External Micrometers are intended for external measurement. Generally they can read to accuracy of 10 microns and in special case up to 1 micron accuracy. Micrometer work on the principle of screw and nut. Generally the pitch of the screw is 0.5mm. Thimble is divided into 50 divisions so as to provide a direct reading of

$$\frac{pitch}{n} = \frac{0.5}{50} = 0.01 \text{ mm}$$

Least count of micrometer is value of 1 division on thimble, which is connected to the screw.

Micrometers with a measuring capacity greater than 25mm are supplied with a setting standard. Micrometers with a 300mm measuring capacity have an interchangeable or adjustable anvil that allows the measuring range to be increased by 100mm

RATCHET MECHANISM

Ratchet stop is provided for constant measuring pressure. The ratchet automatically slips when the correct pressure (uniform) is applied and prevents the application of too much pressure

THE VERNIER MICROMETER

The vernier principle may also be applied to an outside micrometer for increasing its accuracy. It gives an accuracy of 1 micron. The vernier scale is engraved on the micrometer barrel.

SPECIFICATIONS

Range :
Least Count (L.C) :
Zero Correction :

OBSERVATIONS

Sl No.	MainScale Reading (X)	Thimble Reading (Y)	Actual reading X+(Y x L.C)
1			
2			
3			
4			

There are 10 divisions on vernier scale, and these are equal to 9 divisions on the thimble.

Hence, 1 divisions on vernier scale $= \frac{9}{10} \times 0.01 = 0.009$ mm

Least Count = 1 M.S.D ~ 1 V.S.D = 0.01 ~ 0.009 = 0.001 mm

PRECAUTIONS

Clean the micrometer for the oil, dirt, grease etc Clean the measuring face of anvil and spindle

Check the instrument for zero error OR Adjust the micrometer for correct zero setting if needed When the measuring faces of the micrometer are in contact with one another or with a setting standard, the zero mark on the thimble should coincide with the index line and the zero mark on the barrel scale (sleeve). If the setting proves incorrect, lock the spindle, disengage the thimble from the spindle, adjust the position of the thimble and fix it.

PROCEDURE

1. Select a micrometer with desired range depending on the size of work to be measured.
2. Hold the part whose dimension is to be measured on the left hand and micrometer in the right hand
3. Set the micrometer dimension slightly larger than the size of the part and slide the part over the contact surface of the micrometer gently
4. Take thimble reading which coincide with the reference line on the sleeve

5. Actual reading = [M.S.R + (Reading on the thimble x L.C)]

RESULT

INFERENCE

12. STRAIN MEASUREMENT WITH DATA ACQUISITION SYSTEM

AIM

a) Calibrate the load cell by using data acquisition system.
b) Determine the static sensitivity by plotting graph micro strain Vs laod.

APPARATUS

1. Data acquisition system
2. Load cell arrangement
3. A set of weights

SPECIFICATION

Number of channels	= 32
Measuring range	= strain gauge ± 32000 micro strains per transducer
Resolution for strain gauges	= 1 micro strain
Number of samples	= up to 4000 sample

PRINCIPLE

Four strain gauges forming a Wheatstone bridge are located on a cantilever beam. Since a strain gauge is passive transducer an exciting voltage of 5V is applied to the bridge. At no load, the bridge is balanced and the compressive and tensile stresses are also equal. This set up measures strain in ga uges bonded to it and the bridge gets balanced. The resulting bridge output is cond uct ed and amplified.Static sensitivity and gain are determined from the slope of the graph of bridge voltage Vs amplified voltage.

PROCEDURE

Con nections of the load cell were arra nged in full bridge condition. The Wires are con nected to the pipe pin con nectors on rear pa nel of the data acquisition module. Pi n no.1 is con nected to the exci tation vol tage +5 V. Pi n 2 is connected to the grou nd. P i n 4 a n d 5 are con nected to the signal on front p a n e l of data a c q u i s i t i o n system. Two main con trol components are avai lable, that is keyboard and al phan u meric LCD.

LCD - this is a 20*4 alpha n u meric LCD, where all the data and message will appear.

KEYBOARD - the keyboard is used for monitori ng the system, edit chan nel number and for recording.

Add weights on the load cell in steps 0f l Kg. Measure the corresponding micro strain from t he LCD of t he data a c q u i s i t i o n system.

OBSERVATIONS

Sl.No.	Input (q_i) (Kg)	Output (q_o) (□ stra□n)	qi x q_o	qi^2	$\frac{q_o - b}{m}$	**$[(q_o – b/m) – (q_i)]^2$**	Sensitivity $\Delta q_o/\Delta q_i$ (□ stra□n) / Kg
1.							
2.							
3.							
4.							
5.							

CALCULATIONS

a) Static sensitivity = $\Delta q_o/q_i$ (from graph)

where q_o= increment in micro strain (□ stra□n)

q_i= corresponding increment in load (Kg)

b) standard deviation, □

$$\square = \sqrt{1}/\square \sum[(q_0 - b/m) - (q_i)]^2$$

Where, q_o = Output strain

b = Y Intercept

m = Slope

N = Number of observations

$$m = \frac{N\sum q_\square q_\square - \sum q_\square}{N\sum q_\square^2 - (\sum q_\square)^2} \qquad b = \frac{\sum q_\square \sum q_\square^2 - \sum q_\square q_\square \sum q_\square}{N\sum q_\square^2 - (\sum q_\square)^2}$$

c) Imprecision of the instrument = ±3□ Nm

RESULT

4. Sensitivity from observation (m) = -------------------------- micro strain/Kg
5. Sensitivity from graph = -------------------------- micro strain/Kg

Imprecision of the instrument = -------------------------- kg

INFERENCE