COURSE FILE
(MMT LAB)

Vidya Jyothi Institute of Technology

(Accredited by NBA, Approved by AICTE New Delhi)

Aziz nagar Gate, C.B. Post, Hyderabad-500 075

DEPARTMENT OF MECHANICAL ENGINEERING

REGULATION : R15

BATCH :2017-2021

ACADEMIC YEAR : 2019-2020

PROGRAM :B.TECH

YEAR/SEM : III/I

COURSE NAME : METROLOGY AND MACHONE TOOL LAB

COURSE CODE : A15320

NAME OF THE FACULTY: **SHAIK MOHD AMOODI**

DESIGNATION: **ASSISTANT PROFESSOR**

LABORATORY COURSE FILE INDEX

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Vidya Jyothi Institute of Technology (Autonomous)

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(Aziz Nagar, C.B.Post, Hyderabad -500075)

II/III/IV B.Tech I & II Semester Academic Calendar for the Academic Year 2019-20

II/III/IV YEAR I SEMESTER		**Commencement of Class Work 17.06.2019**	
	From	**To**	**Duration**
I Spell of Instruction	17.06.2019	10.08.2019	8 WEEKS
I Mid Examinations	13.08.2019	17.08.2019	4 DAYS
II Spell of Instruction	19.08.2019	05.10.2019	7 WEEKS
Dussehra Holidays	07.10.2019	12.10.2019	1 WEEK
II Spell of Instruction Continuation	14.10.2019	19.10.2019	1 WEEK
II Mid Examinations	21.10.2019	24.10.2019	4 DAYS
Practical Examinations	25.10.2019	29.10.2019	4 DAYS
Betterment Examinations	30.10.2019	01.11.2019	3 DAYS
End Semester Examinations	02.11.2019	18.11.2019	2 WEEKS
Supplementary Examinations	19.11.2019	04.12.2019	2 WEEKS
II/III/IV YEAR II SEMESTER		**Commencement of Class Work 02.12.2019**	
I Spell of Instruction	02.12.2019	10.01.2020	6 WEEKS
Pongal Holidays	11.01.2020	15.01.2020	5 DAYS
Technical/Sports fest	16.01.2020	18.01.2020	3 DAYS
I Spell of Instruction Continuation	20.01.2020	01.02.2020	2 WEEKS
I Mid Examinations	03.02.2020	08.02.2020	1 WEEK
II Spell of Instruction	10.02.2020	04.04.2020	8 WEEKS
II Mid Examinations	06.04.2020	09.04.2020	4 DAYS
Practical Examinations	13.04.2020	17.04.2020	4 DAYS
Betterment Examinations	18.04.2020	22.04.2020	4 DAYS
End Semester Examinations	23.04.2020	08.05.2020	2 WEEKS
Supplementary Examinations	11.05.2020	23.05.2020	2 WEEKS
Commencement of classes will be from			

DIRECTOR

COURSE OUTCOMES

COURSE OUTCOMES R15

L	T	P	C
0	0	2	1

Course Outcomes

1: Identify suitable instrument for measuring dimensions and surface roughness of a given component.

2: Perform alignment and flatness tests on given machine and component.

3: Perform wear resistance test and know the usage of tool makers microscope.

4. Operate lathe, milling machines, drilling machine, grinding machines.

5. Select suitable machining operation to fabricate the required product from the given raw material.

MAPPING OF POS AND COS

		PO 1	PO2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2
Machine Tools and Metrology / A15320	CO1	3	3	3	3	-	-	3	2	3	-	-	3	-	3
	CO2	3	3	3	3	3	-	-	2	3	-	-	3	-	3
	CO3	3	3	3	3	3	-	3	-	3	-	-	3	-	3
	CO4	3	3	3	2	3	-	3	2	-	-	-	3	-	3
	CO5	3	3	2	3	-	-	2	-	-	-	-	3	-	2
AVG		**3**	**3**	**2.8**	**2.8**	**3.00**	**-**	**2.75**	**2**	**3**	**-**	**-**	**3**	**-**	**2.8**

COURSE OUTCOMES R18

L	T	P	C
0	0	2	1

Course Outcomes

1: Identify suitable instrument for measuring dimensions and surface roughness of a given component.

2: Perform alignment and flatness tests on given machine and component.

3: Perform wear resistance test and know the usage of tool makers microscope.

MAPPING OF POS AND COS

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Metrology and Machine Tools Lab/ A26388	**CO1**	3	3	2	2	2			1	3	3		3	3	3
	CO2	3	3	2	2	3		2	1	3	3		2	2	2
	CO3	3	3	2	1	3		2	1	3	3		1	2	2
AVG		**3**	**3**	**2**	**1.67**	**2.67**		**2**	**1**	**3**	**3**		**2**	**2.33**	**2.33**

Time Tables

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(Aziz Nagar, C.B.Post, Hyderabad -500075)

DEPARTMENT OF MECHANICAL ENGINERRING

TIMETABLE

A.Y- 2019-20 **w.e.f. 22/07/2019**

III B.Tech I Sem **SECTION-A**

TIME/ DAY	9.00- 9.55	9.55-10.50	10.50.11-45	11.45-12.30	12.30-1.25	1.25-2.20	2.20-3.15	3.15-4.05
MON				LUNCH BREAK				
TUE						TE/MT LAB		
WED								
THU								
FRI						MT/TE LAB		
SAT								

H.O.D
Dr.G.Sreeram Reddy

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DEPARTMENT OF MECHANICAL ENGINERRING

TIMETABLE

A.Y- 2019-20 **w.e.f. 22/07/2019**

III B.Tech I Sem **SECTION-B**

TIME/ DAY	9.00- 9.55	9.55-10.50	10.50.11-45	11.45-12.30	12.30-1.25	1.25-2.20	2.20-3.15	3.15-4.05
MON	TE/MT LAB			LUNCH BREAK				
TUE								
WED						MT/TE LAB		
THU								
FRI								
SAT								

H.O.D
Dr.G.Sreeram Reddy

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DEPARTMENT OF MECHANICAL ENGINERRING

TIMETABLE

A.Y- 2019-20 **w.e.f. 22/07/2019**

III B.Tech I Sem **SECTION-C**

TIME/ DAY	9.00- 9.55	9.55-10.50	10.50.11-45	11.45-12.30	12.30-1.25	1.25-2.20	2.20-3.15	3.15-4.05
MON				LUNCH BREAK				
TUE						TE/MT LAB		
WED								
THU								
FRI	MT/TE LAB							
SAT								

H.O.D
Dr.G.Sreeram Reddy

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DEPARTMENT OF MECHANICAL ENGINERRING

TIMETABLE

A.Y- 2019-20 **w.e.f. 22/07/2019**

III B.Tech I Sem **SECTION-D**

TIME/ DAY	9.00- 9.55	9.55-10.50	10.50.11-45	11.45-12.30	12.30-1.25	1.25-2.20	2.20-3.15	3.15-4.05
MON				LUNCH BREAK		TE/MT LAB		
TUE								
WED								
THU	MT/TE LAB							
FRI								
SAT								

H.O.D
Dr.G.Sreeram Reddy

LIST OF EXPERIMENTS

III YEAR B.TECH.ME-I SEM	L	T/P/D	C
	-	-/2/-	1

(**A15320**) MACHINE TOOLS & METROLOGY LAB EXPERIMENTS LIST

SECTION – A

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth, vernier calipers and checking the chordal addendum and choral height of spur gear.
4. Machine tool alignment test on the lathe.
5. Tool maker's microscope.
6. Angle and taper measurements by Bevel protractor & Sine bars.
7. Use of spirit level in finding the flatness of surface plate.
8. Thread measurement by two wire / three wire method or Tool Makers' microscope.

SECTION – B

1. Introduction of general purpose machines – Lathe, Drilling Machine, Milling Machine, and shaper.
2. Planning Machine, Slotting Machine, and Cylindrical Grinder, Surface Grinder and Tool and Cutter grinder.
3. Step turning and Taper Turning on Lathe Machine.
4. Thread cutting and knurling on lathe machine.
5. Drilling and Tapping
6. Shaping and Planning
7. Slotting
8. Milling
9. Cylindrical Surface Grinding

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LIST OF EQUIPMENT IN LABORATORY

DEPARTMENT OF MECHANICAL ENGINEERING
MACHINE TOOLS & METROLOGY LAB

LIST OF EQUIPMENT

MACHINE TOOLS

1. LATHE MACHINE ACCESSORIES
2. RADIAL DRILLING MACHINE
3. MILLING MACHINE ACCESSORIES
4. SURFACE GRINDER
5. CUTTER AND TOOL GRINDER
6. SLOTTING MACHINE
7. SHAPING MACHINE
8. PLANNING MACHINE
9. CYLINDRICAL GRINDER
10. BENCH GRINDER

METROLOGY

1. GEAR TOOTH VERNIER CALIPER
2. BEVEL PROTRACTOR
3. SINE BAR
4. SLIP GUAGE BOX
5. SPIRIT LEVEL
6. TOOL MAKERS MICROSCOPE
7. GRANITE SURFACE PLATE
8. VERNIER CALIPER
9. DIAL BORE GAUGE
10. DIAL INDICATOR
11. OUTSIDE MICROMETER
12. INSIDE MICROMETER
13. CAST IRON SURFACE PLATE
14. TEST MANDREL
15. THREAD MEASURING EQUIPMENT

LABORATORY MANUAL

VIDYA JYOTHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

III Year B. Tech. MECH - I Sem	**L**	**T / P / D**	**C**
	0	- / 3 / -	2

(A15387) METROLOGY AND MACHINE TOOLS LAB

SECTION – A:

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth, vernier calipers and checking the chordal addendum and choral height of spur gear.
4. Machine tool alignment test on the lathe.
5. Tool maker's microscope.
6. Angle and taper measurements by Bevel protractor & sine bars.
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8. Thread measurement by Two wire / Three wire method or Tool makers microscope.

SECTION – B

1. Introduction of general purpose machines – Lathe, Drilling machine, Milling machine, shaper.
2. Planning machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
3. Step turning and taper turning on lathe machine.
4. Thread cutting and knurling on lathe machine.
5. Drilling and tapping
6. Shaping and planning
7. Slotting
8. Milling
9. Cylindrical surface grinding

METROLOGY LAB

MEASURING OF DIAMETER BY VERNIER CALIPERS

Aim:

To measure the diameters of the given work piece at various sections using Vernier Calipers.

Equipment Required:

1. Vernier Calipers with Least Count = 1mm/50 OR 0.02mm
2. Work piece of various cross sections with different diameters.

Principle:

Vernier Calipers is the most commonly used instrument for measuring outer and inner diameters. It works on the principle of Vernier Scale which is some fixed units of length (Ex: 49mm) divided into 1 less or 1 more parts of the unit(Ex: 49mm are divided into 50 parts). The exact measurement with upto 0.02mm accuracy can be determined by the coinciding line between Main Scale and Vernier Scale.

Total Reading = M.S.R + L.C X V.C

Where:

M.S.R – Main Scale Reading

L.C – Least Count

V.C – Vernier Coincidence

Procedure:

1. The Least Count is to be determined.

L.C = (Minimum Main Scale Reading) / (No. of Vernier Scale Divisions)

2. The workpiece is placed between the jaws of Vernier Calipers correctly.
3. The reading on Main scale which is just behind the first Vernier Scale Division is noted as Main Scale Reading.
4. The Division on Vernier Scale which coincides with the line on Main Scale is noted down as Vernier Coincidence.
5. The Diameter can be calculated using the given Formula.

Precautions:

1. Make sure the Vernier Calipers are clean.
2. Clean the measuring faces with paper or cloth.
3. Make sure the workpiece axis is perpendicular to the Vernier Calipers.

Result:

Outside diameter of the work piece No 1:

Outside diameter of the work piece No 2:

Outside diameter of the work piece No 3:

S No	Main Scale Reading	Thimble Scale Coincidence	Zero Error	Thimble Scale Reading	Total Length
a.1					
a.2					
a.3					
b.1					
b.2					
b.3					
b.1					
b.2					
b.3					

Calculations:

MEASURING OF THICKNESS BY OUTSIDE MICROMETER

Aim:

To measure the thickness of the given work piece at various sections using micrometer.

Equipment Required:

3. Outside micrometers range = (0-25mm)
4. Work piece of various thicknesses.

Principle:

Micrometer is one of the most common and most popular forms of measuring instrument for precise measurement with 0.01mm accuracy. It works on the principle of screw and nut. We know that when a screw is rotated through one revolution it advances by one pitch distance i.e. one rotation of screw corresponding to a linear movement of a distance equal to pitch of the screw thread. If the circumference of the screw is divided into number of equal parts say n its rotation through one division will cause the screw to advance through (pitch/n) length.

Least Count of Micrometers:

Least count is the minimum distance which can be measurement accurately by the instruments. The micrometer has a screw of 0.5mm pitch, with a thimble graduated in 50 divisions to provide a direct reading of pitch/n. Least count of micrometer

Total Reading = Main Scale Reading + L.C x (Thimble Scale Coincidence ± error)

Procedure:

1. The least count is to be determined.
2. The w/p is placed between the two anvils after the instruments are adjusted for zero error.
3. Work piece is held strongly without applying under pressure on the instrument.
4. The value of the main scale is noted down. The main scale division just coincides with the index line. This is called the main scale division which just procedures edge of the main scale is noted down. This is called thimble scale reading (T.S.R).

Diameter of the work piece is given by D= main scale reading + L.C. x (Thimble scale reading)

Precautions:

1. First clean the micrometer by wiping off all the dirt, dust and grit etc.
2. Clean the measuring faces of paper or cloth.
3. Set the zero reading of the instrument to before measuring

Observations;

1. First least count of the outside micrometer must be cal

2. The corresponding readings are then enforced into following tables.

Result:

Outside diameter of the work piece No 1:

Outside diameter of the work piece No 2:

Outside diameter of the work piece No 3:

S No	Main Scale Reading	Thimble Scale Coincidence	Thimble Scale Reading	Zero Error	Total Length
a.1					
a.2					
a.3					
b.1					
b.2					
b.3					
b.1					
b.2					
b.3					

Calculations:

MEASURING OF INTERNAL BORES BY INSIDE MICROMETER

Aim:

To measure the diameters of the given work piece at various sections using micrometer.

Equipment Required:

1. Outside micrometers range = (0-25mm)
2. Work piece of various cross sections with different diameters.

Principle:

Micrometer is one of the most common and most popular forms of measuring instrument for precise measurement with 0.01mm accuracy. It works on the principle of screw and nut. We know that when a screw is rotated through one revolution it advances by one pitch distance i.e. one rotation of screw corresponding to a linear movement of a distance equal to pitch of the screw thread. If the circumference of the screw is divided into number of equal parts say n its rotation through one division will cause the screw to advance through (pitch/n) length.

Least Count of Micrometers:

Least count is the minimum distance which can be measurement accurately by the instruments. The micrometer has a screw of 0.5mm pitch, with a thimble graduated in 50 divisions to provide a direct reading of pitch/n. Least count of micrometer

Total reading = main scale reading + L.C x (reading on thimble)

Procedure:

1. The least count is to be determined.
2. The w/p is placed between the two anvils after the instruments are adjusted for zero error.
3. Work piece is held strongly without applying under pressure on the instrument.
4. The value of the main scale is noted down. The main scale division just coincides with the index line. This is called the main scale division which just procedures edge of the main scale is noted down. This is called thimble scale reading (T.S.R).

Diameter of the work piece is given by

D= main scale reading + L.C. x (Thimble scale reading)

Precautions:

1. First clean the micrometer by wiping off all the dirt, dust and grit etc.
2. Clean the measuring faces of paper or cloth.
3. Set the zero reading of the instrument to before measuring

Observations;

1. First least count of the outside micrometer must be cal

2. The corresponding readings are then enforced into following tables.

Result:

Outside diameter of the work piece No 1:

Outside diameter of the work piece No 2:

Outside diameter of the work piece No 3:

S No	Size of Sine Bar	Center to Center Distance (L)	Slip Gauge Combination (h2)	h=h1-h2	Sin(θ) = h/L	θ
a.1						
a.2						
a.3						
b.1						
b.2						
b.3						
b.1						
b.2						
b.3						

Calculations:

3. MEASUREMENT OF SPUR GEAR USING GEAR TOOTH VERNIER

Aim: To measure spur gear tooth thickness by using gear tooth vernier.

Instruments and material required:

a) Gear tooth vernier caliper

b) Spur gear

Basic terminology of Gear tooth:

Pitch circle diameter (P.C.D): It is the diameter of a circle which by pure rolling action would produce the same motion as the toothed gear wheel.

Module (m): It is defined as the Length of the pitch circle diameter per tooth. Thus if P.C.D of Gear be 'D' and number of tooth 'N' then module (m) = D/N. It is generally expressed in mm.

Diameter pitch: It is expressed as the number of teeth per inch of the P.C.D.

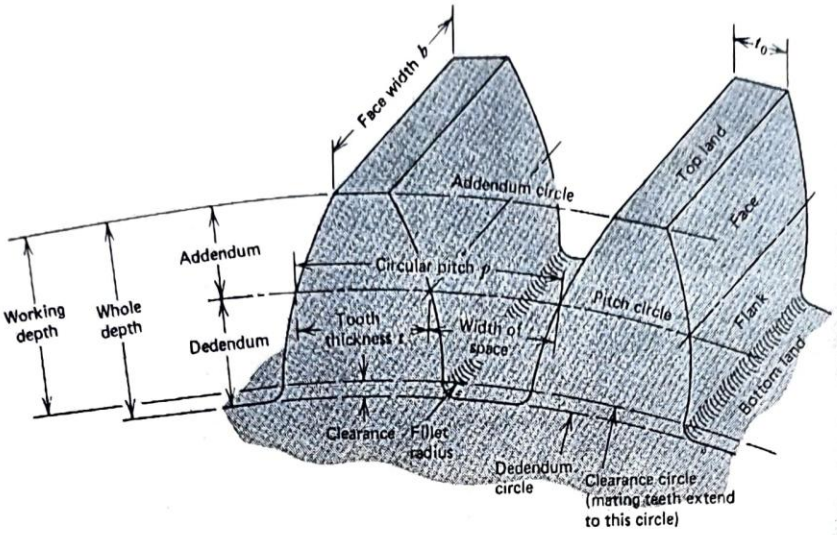
Circular pitch: It is the arc distance measured around the pitch circle from the flank of one tooth to a similar flank in the next tooth. Therefore $CP = \Pi D / N = \Pi m$.

Addendum: This is the radial distance from the pitch circle to the tip of the tooth. Its value is equal to one module.

Clearance: This is the radial distance from the tip of a tooth to the bottom of a mating tooth space when the teeth are symmetrically engaged. Its standard value is 0.157 m.

Dedendum: Addendum + Clearance $= m + 0.157m = 1.157m$

Blank diameter: This is the diameter of the blank from which gear is cut. It is equal to P.C.D plus twice the addendum



Blank diameter = P.C.D + 2m = mN + 2m = m (N+2)

Tooth thickness: This is the arc distance measured along the pitch circle from its intercept with one flank to its intercept with the other flank of the same tooth

Normally tooth thickness = C.P/2 = Π m/2

But thickness is usually reduced by certain amount to Allow for some amount of backlash and also owing to addendum correction.

Face of tooth: It is that part of the tooth surface which is above pitch surface.

Flank of tooth: It is the part of the tooth surface which is lying below the pitch surface.

Measurement of tooth thickness:The permissible error or the tolerance on the thickness of tooth is the variation of actual thickness of the tooth from its theoretical value. The tooth thickness is generally measured at pitch circle and is therefore the pitch line thickness of tooth i.e. length of an arc which is difficult to measure directly. In most of the cases, it is sufficient to measure the chordal thickness i.e. the chord joining the intersection of the tooth profile with the pitch circle. Also the difference between chordal tooth thickness and circular tooth thickness is very small for gear of small pitch. The thickness measurement is the

most important measurement because most of the gears manufactured may not undergo checking of all other parameter, but thickness measurement is a must, for all gears.

The tooth thickness can be very conveniently measured by a gear tooth vernier. Since the gear tooth thickness varies from the tip to the base circle of the tooth. The instrument must be capable of measuring tooth thickness at a specified position on the tooth. Further this is possible only when there is some arrangement to fix that position where the measurement is to be taken. The gear tooth vernier has two vernier scales and they are set for width (w) of the tooth and the depth (d) from the top, at which 'w' occurs.

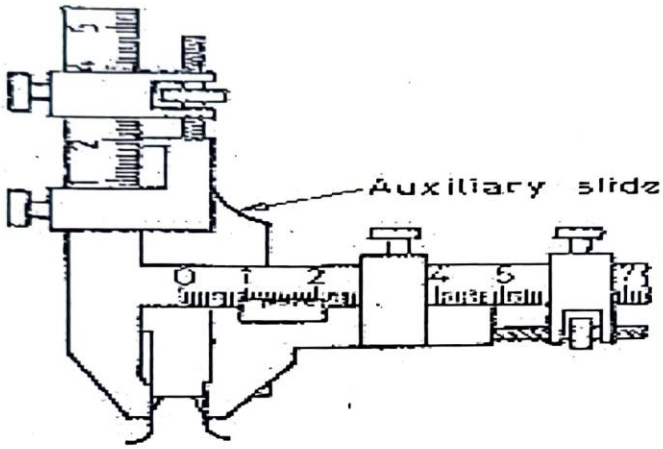


Fig. 12.17 Gear-tooth vernier

Considering one gear tooth, the theoretical value of 'w' and 'd' can be found which may be verified by the instrument.

Chordal thickness = W = AB = 2AD

$\angle$ AOD = $\Theta = 360^\circ / 4N$, Where 'N' is the number of teeth.

$W = 2 \times AD = 2 \times AO$, $\sin\Theta = 2R$, $\sin 360^\circ/4N$ (R = Pitch circle radius)

Module (m) = P.C.D / number of teeth = 2R/n

R = N.m / 2

Chordal thickness (W) = $2.(N\ m/2) \sin (360^\circ /4N) = N.m \sin (90^\circ / n)$

Also from fig $d = OC - OD$,

But $OC = OE + \text{Addendum} = R + m = (N.m/2) + m$ and

But $OD = R \cos \Theta = Nm/2 \cos (90^\circ /N)$,

$\therefore d = (N.m /2) + m - (Nm/2) \cos(90^\circ /N)$

$\therefore$ chordal addendum $(d) = (N.m /2) [1 + 2 /N - \cos (90^\circ /N)]$ ---------- (1.1)

S.No.	Main scale reading M.S.R (mm)	V.C (mm)	L.C	V.S.R = V.C X L.C	Total = M.S.R+V.S.R (mm)
1					
2					
3					
4					
5					
6					

Total Average = 3.50 mm

Model calculations:-

No. of teeth = 64

Outside diameter $(D_0) = 140$ mm

Width of the Gear = 18.7 mm

$$\text{Circular pitch} = \frac{\Pi D_0}{N} = \frac{3.14 \times 140}{64} = 6.87 \Rightarrow 6.9$$

Theoritical values:-

$$\text{Modules, } m = \frac{D_0}{(N+2)} = \frac{140}{(64+2)} = 2.12 \text{ mm}$$

$$\text{Chordal addendum, } d = \frac{N\,m}{2} \times \left[1 + \frac{2}{N} - \cos\left(\frac{90}{N}\right)\right]$$

$$= \frac{64 \times 2.12}{2} \times \left[1 + \frac{2}{64} - \cos\left(\frac{90}{64}\right)\right] = 2.14 \text{ mm}$$

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

$= 64 \times 2.12 \sin(90 / 64)$

$= 3.329$ mm

Practical value: -

Chordal thickness, $W = 3.5$ mm from table

$$\text{Modules, } m = \frac{W}{N \times \sin(90/N)} = \frac{3.5}{64 \times \sin(90/64)} = \frac{3.5}{1.57} = 2.23\text{mm}$$

$$\text{Chordal addendum, } d = \frac{N\,m}{2} = \left[1 + \frac{2}{N} - \cos\left(\frac{90}{N}\right)\right]$$

$$= \frac{64 \times 2.23}{2} = \left[1 + \frac{2}{64} - \cos\left(\frac{90}{64}\right)\right]$$

$= 2.25$ mm

Conclusion : -

Theoritical value	Practical value
m = 2.12 mm	m =
d = 2.14 mm	d =
W = 3.329 mm	W =

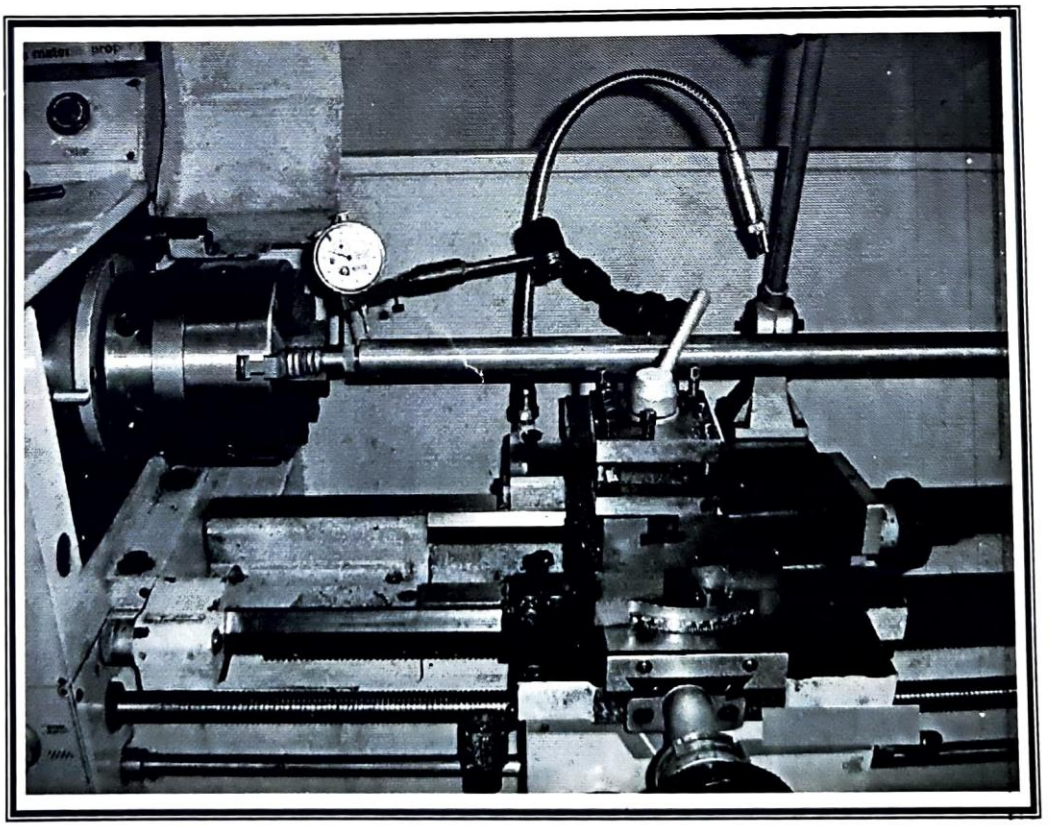
Procedure:

i) Count the number of teeth (N) on the gear.
ii) Measure the outside diameter (D0) of the gear.
iii) Calculate the module from the relation, m = D0 / (N+2)
iv) Calculate the values of chordal addendum (d) from equation (5.1)
v) Set the gear tooth vernier callipers for depth 'd' and measure 'W' i.e. Chordal thickness of tooth.
vi) Repeat the measurement on the other tooth and determine an average value.

Result:

The theoretical value of gear tooth thickness may differ from the measured value due to the Manufacturing inaccuracies.

MACHINE TOOL ALIGNMENT TESTS



MACHINE TOOL TESTING

INTRODUCTION:

The surface components produced by machining processes are mostly by generation. As a result, the quality of surface produced depends upon the accuracy of the various movements of the machine tool concerned. It therefore becomes important to know the capability of the machine tool by evaluating the accuracy of the various mechanisms that are directly responsible for generating the surface. For this purpose a large variety of tests have been designed.

MEASURING INSTRUMENTS USED FOR TESTING:

The accuracy of the machine tools employed should be higher than the accuracy of the components that it produces. Similarly the quality of the measuring equipment used for machine tool testing should be commensurate with the quality expected from such testing. A few commonly used equipments are

- Dial Indicators
- Test mandrels
- Straight edges
- Spirit levels

TEST PROCEDURES:

The major tests that are conducted on machine tool are:

- Testing the quality of the slide ways and the locating surfaces
- Testing the accuracy of the main spindle and its alignment with respect to other parts of the machine tool.
- Testing the accuracy of the parts produced by the machine tool.

ACCEPTANCE TESTS

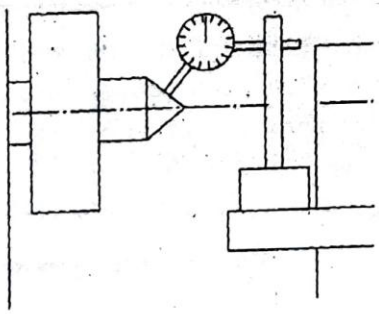
LATHE MACHINE

Tests that can be conducted on Lathe machine:

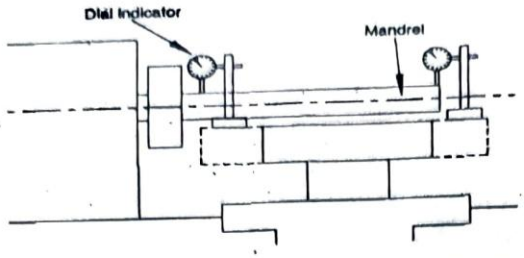
1. **Quality of slide ways**: To test the quality of the slide ways it is necessary to mount the dial indicator on a good datum surface. Then the plunger is moved along the longitudinal direction of the slide ways which provides an indication of the undulations present on the surface of the slide ways.
2. **Accuracy of the spindle**:

   These tests are related to the true running of the spindle and the centre located in the spindle along with the alignment, parallelism and perpendicularity of the spindle with the other axes of the concerned machine tool.

   True running of the centre: The live centre may be loaded into the lathe spindle and a dial indicator mounted as shown in fig. This test is required only for machines where the work piece is held between centres. The readings of the dial indicator are taken while rotating the spindle through full rotation.



True running of the spindle: the taper shank of the test mandrel of about 300 mm length is mounted into the spindle as shown in fig. The plunger of the dial indicator rests on the cylindrical surface of the mandrel. The spindle is rotated slowly and the readings of the dial indicator are noted. The deviation should normally be less than 0.01mm. The test is to be repeated with the dial indicator positioned close to the spindle bore as well as at the extreme end of the test mandrel.

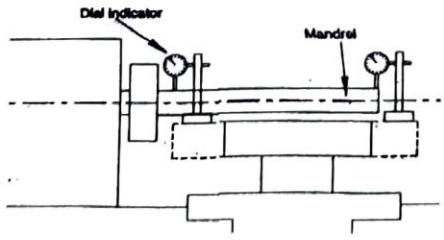


Test set-up for true running of the spindle of a lathe

Squreness of the face: this test is used to measure the squreness of the shoulder face with reference to the spindle axis. The plunger of the dial indicator rests on the extreme radial position of the shoulder face and the reading is taken. It is repeated by slowly rotating the spindle till the dial indicator comes to a point that is diametrically opposite to the reading taken earlier.

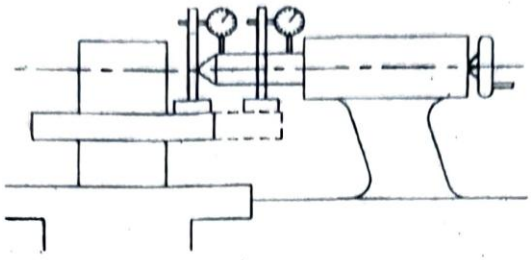
3. **Alignment tests**:

Parallelism and perpendicularity: Parallelism and perpendicularity between two axes or two surfaces is normally measured in two planes, horizontal and vertical. For this purpose the test mandrel is mounted in the spindle as shown in fig. with dial indicator mounted on the saddle or carriage. The plunger of the dial indicator touches the mandrel surface as shown in fig. the saddle is moved for a specified distance and the dial reading noted. The test is repeated in the horizontal direction as well.



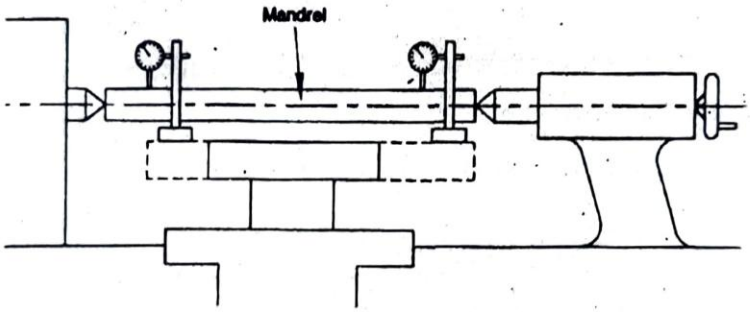
Test set-up for parallelism between the spindle axis and the slideways in a lathe

Parallelism between the outside diameter of the tail stock sleeve and the slide ways as shown in fig.



Test set-up for the parallelism of the tail stock sleeve

Parallelism between the line of centres and the slide ways shown in fig.

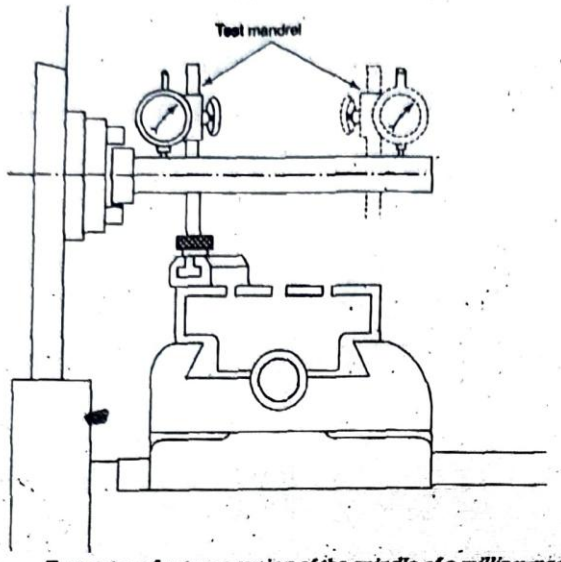


Test set-up for parallelism of the line of centres in a lathe

MILLING MACHINE:

The following tests can be conducted:

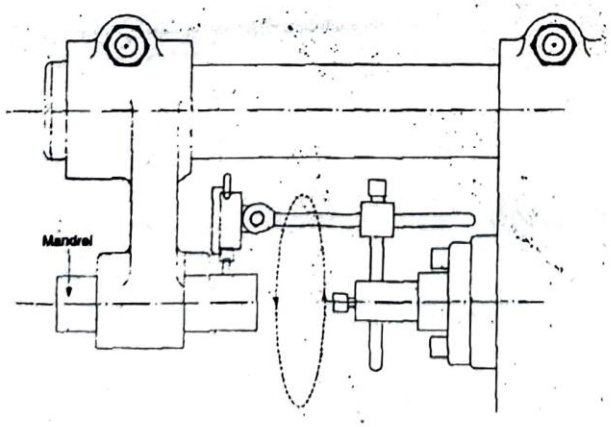
1. **True running of the spindle:**



Test set-up for true running of the spindle of a milling machine

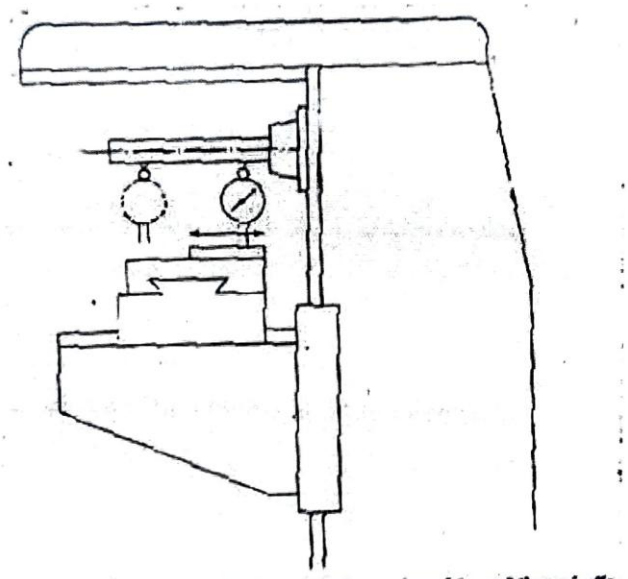
2. **Spindle alignment:**

   In this test dial indicator is mounted on one of the surfaces whose alignment is to be tested with another surface. In case of a horizontal milling machine the testing of the alignment between the spindle and the over arm support can be done as shown in fig.



The dial indicator is mounted on the spindle while a test mandrel is mounted in the over arm support with the plunger of the dial indicator resting on the cylindrical surface of the test mandrel. The spindle is rotated and readings are taken when it is at different positions on the periphery of the test mandrel. The test may be conducted at two extreme ends of the mandrel.

Parallelism between the table and the spindle axis shown in fig. A test mandrel 300mm long is mounted in the spindle axis and the dial indicator is mounted on the table. The reading of the dial indicator is taken at the two extreme positions with out the table movement.



Test set-up for parallelism between the table and the spindle axis in a horizontal milling machine

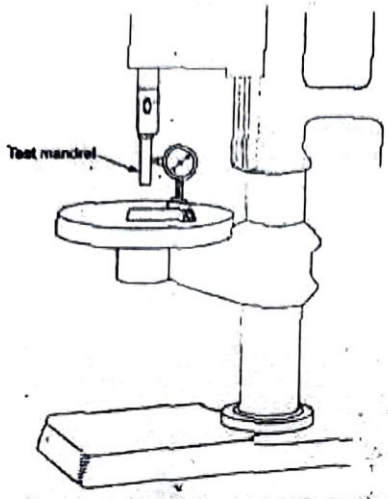
Other tests that can be conducted are:

- Parallelism between the spindle axis and the transverse movement of the table.
- Perpendicularity between the spindle and the vertical column ways.

RADIAL DRILLING MACHINE:

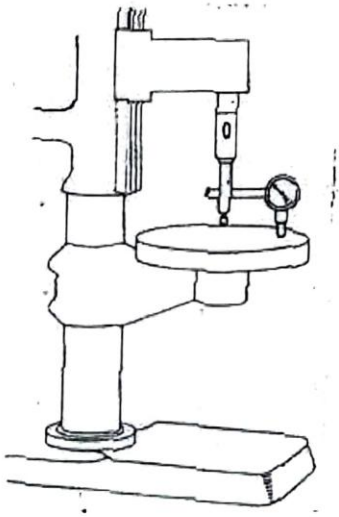
Tests that can be conducted on Drilling Machine are:

1. True running of the spindle.

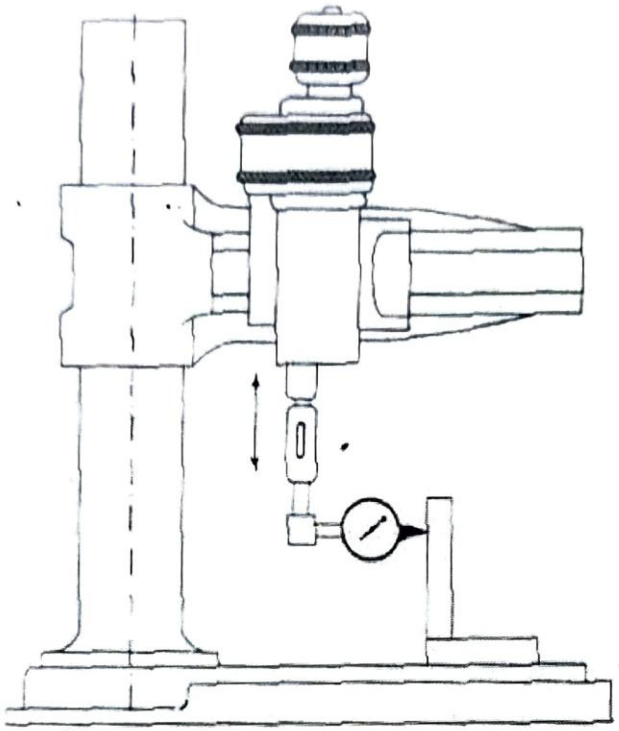


Test set-up for true running of the spindle of a radial drilling machine

2. Perpendicularity between the spindle and the base plate.

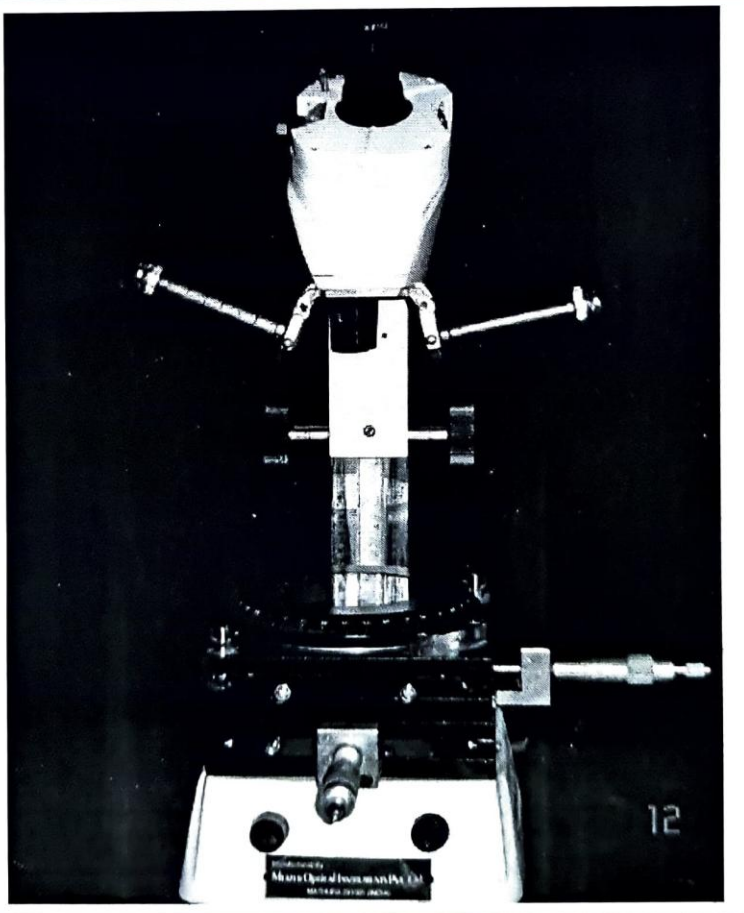


3. Perpendicularity between the feed movement and the base plate.



Test set-up for the perpendicularity between the feed movement and the base plate of a radial drilling machine

MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS BY TOOL MAKER'S MICROSCOPE



MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS BY TOOL MAKERS MICROSCOPE

AIM: To measure the following parameters of threaded specimen of small magnitude:

(1) Major Diameter

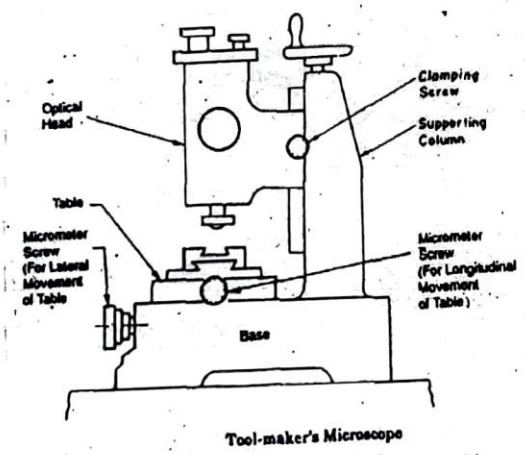
(2) Minor Diameter

(3) Pitch

(4) Included angle

APPARATUS: Tool Maker's Microscope

THEORY:

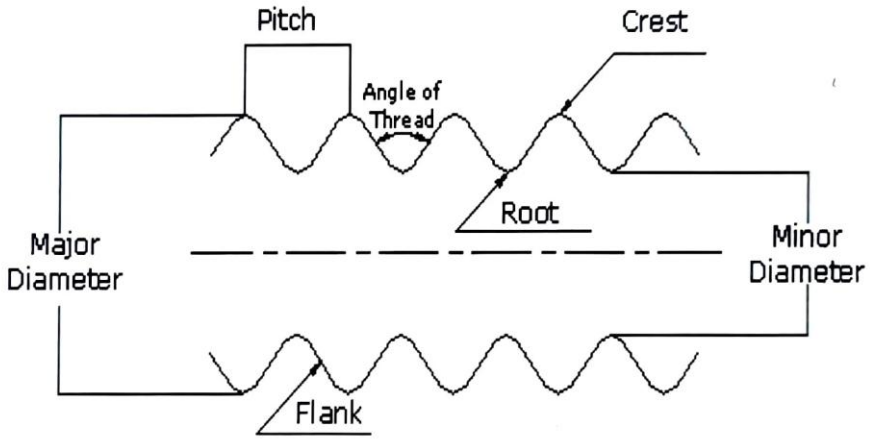


Tool-maker's Microscope

Tool Makers Microscope is an optical device used to view and measure very fine details, shapes and dimensions on small and medium sized tools, dies, and work pieces. It is equipped with a glass table that is movable in two principal directions and can be read to 0.01 mm. Microscope is also equipped with a protractor to measure the angular dimensions. It is also equipped with surface illumination. Provision is available to adjust the height of the viewing head to get a sharp image of the object.

Screw thread is a helical ridge produced by forming a continuous helical groove of the uniform section on the external or internal surface of a cylinder or cone. A screw thread formed on a cylinder is known as straight or parallel, Screw thread, while the one formed on a cone or frustum of a cone is known as tapered screw thread. In the present experiment, parameters of a straight screw thread of small magnitude are measured. Parameters of small screws such as screws used in watches, electrical plugs, and toys cannot be measured using instruments like vernier calipers or micrometers. Unless they are magnified it is not possible to measure all the parameters.

Some parameters of a straight screw thread are defined as follows:



Crest of a thread is defined as the prominent part of thread. Root of a thread is defined as the bottom of the groove between two flanks of thread.

Flanks of thread are straight edges which connect the crest with the root.

Angle of the thread also known as included angle is the angle between the flanks of the thread measured in axial plane.

The pitch of a thread is the distance measured parallel to the axis of the thread, between corresponding points on adjacent thread forms in the same axial plane and on the same side of axis.

Major diameter is the diameter of an imaginary cylinder Co-axial with the screw which just touches the crests of an external thread or roots of an internal thread.

Minor Diameter is the diameter of an imaginary cylinder co-axial with the screw which just touches the roots of an external thread or the crest of an internal thread

PROCEDURE:

1. Determination of the major diameter:

   Keep the specimen on the glass table. Here the given specimen is a thread. Switch on the light to get the silhouette of the thread. Adjust the height of the viewing head until a sharp image appears.

   Adjust the cross line of the instrument as shown below.

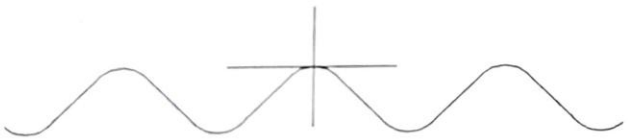


Fig.1

Now note-down the reading of the Micrometer. Now move cross line in such a way that, horizontal cross line occupies other sides of the crests as shown in fig-2. Again note-down the reading of the Micrometer. Difference of the two readings gives the major diameter of the thread.

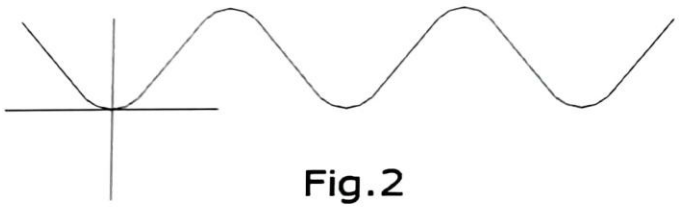


Fig.2

2. Determination of the Minor diameter:

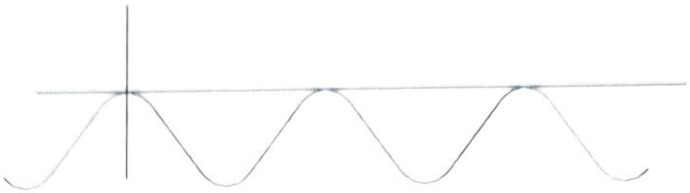


Fig.3

After obtaining the sharp image of the Threaded specimen let the horizontal cross line touch all the root points as shown in fig-3. At this position take the micrometer reading adjust the micrometer in such a way that, same horizontal line touches the other side of the root paints as shown in fig-4. Again note-down the reading of the micrometer. Difference of the readings gives minor diameter.

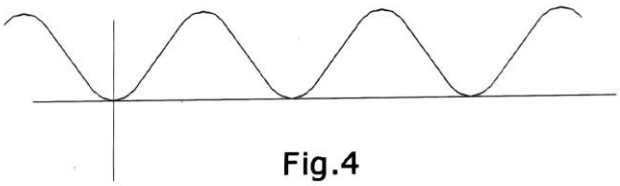


Fig.4

3. Determination of Pitch:

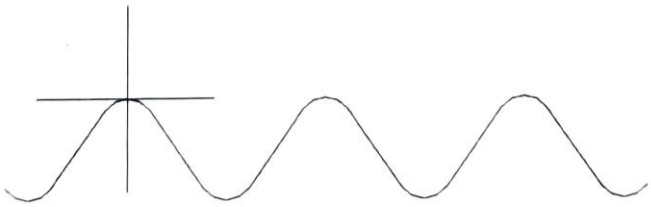


Fig.5

To measure pitch of the thread, align the centre of the cross lines at the peak of the crest as shown in the fig-5. At this position take the micrometer reading. Now move the micrometer in such a way that centre of the cross line align with the peak of the next thread as shown in for-6. Again note-down the reading of the micrometer. Difference of the two readings gives the pitch of the thread.

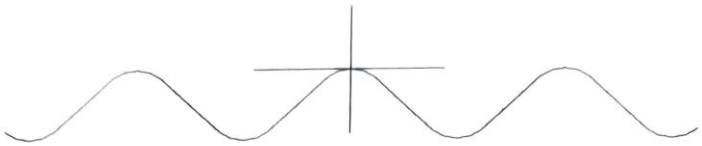


Fig.6

4. Determination of the angle:

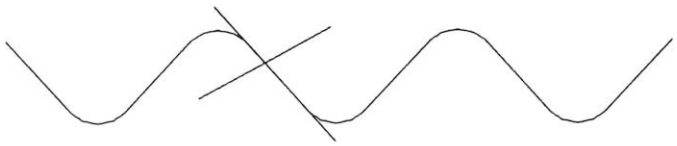


Fig.7

To measure the included angle of the thread coincide one of the lines of the cross lines with the flank of the thread as shown in the fig-7. Note-down the reading of the protractor. Now rotate the protractor in turn the cross lines in such a way that same line coincides with the opposite flank as shown in fig-8. Note-down the reading of the protractor. Difference of the two reading gives the included angle of the thread.

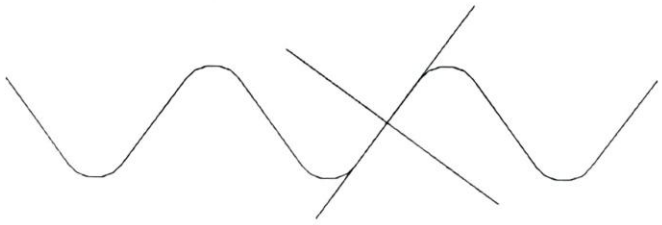


Fig.8

PRECAUTIONS:

1. Students are advised to take readings without any parallax error.
2. Lens must be properly adjusted to get a sharp image.
3. Move the Microscope table by gently holding micrometer thimble.

RESULT:

MEASUREMENT OF TAPER ANGLE USING BEVEL PROTRACTOR

Aim: To find out the taper angle of given work piece by using Bevel Protractor.

Apparatus: Surface Plate, Bevel Protractor, Tapered work piece.

Objectives:

Students will be able to know

- Understand different parts of vernier bevel protractor,
- Know the use and working of bevel protractor,
- Understand the use of vernier bevel protractor.

Theory:

Main parts of bevel protractor are

1. Fixed Base blade and a circular body is attached to it.
2. Adjustable blade.
3. Blade clamp.
4. Scale magnifier lens.
5. Acute angle attachment.

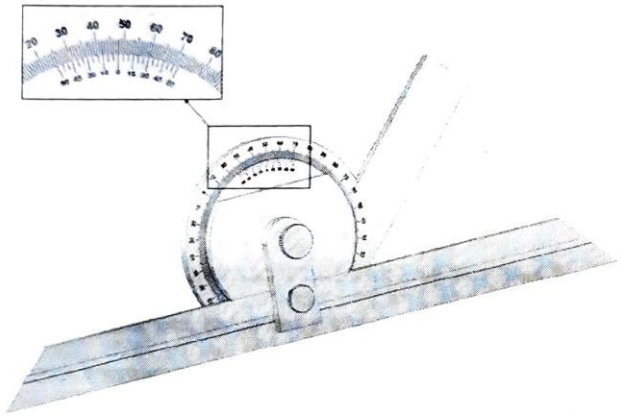
Bevel protractor is used for measuring and lying out of angles accurately and precisely within 5 minutes. The protractor dial is slotted to hold a blade which can be rotated with the dial to the required angle and also independently adjusted to any desired length. The blade can be locked in any position. It is the simplest instrument for measuring the angle between two faces of component. It consists of base plate attached to the main body and an adjustable blade which is attached to a circular plate containing vernier scale. The adjustable blade is capable of rotating freely about the centre of the main scale engraved on the body of the instrument and can be locked in the any position. It is capable of measuring from zero to 3600. The vernier scale has 24 divisions coinciding with 23 main scale divisions. Thus the least count of the instrument is 51. This instrument is most commonly used in work shop for angular measurements. Note the reading, magnifying lens has been provided for easy reading of the instrument. Main scale is circular and is graduated in degrees on the circular body. Main scale graduations are all around the circular body which is attached to fixed base blade. Fixed base blade also called as stock is attached to circular body of bevel protractor as shown in figure. Once the reading is fixed, blade clamp fixes the reading. Blades are about 150 mm long or 300mm long, 13mm wide and 2mm thick. Its ends are bevelled at angles of 45 degree and 60 degree. Vernier scale is also marked on turret which can rotate all over the fixed body.

Adjustable blade can pass through the slot provided in turret. So as the turret rotates, adjustable blade also rotates full 360 degrees. There are 12 graduations of Vernier scale starting from 0 to 60o on both sides of zero of Vernier scale as shown in figure.

Least count of Vernier bevel protractor= $\frac{\text{smallest division on main scale}}{\text{Total no of divisions on Vernier scale}}$

$= 1^{o}$ (equal to 60') i.e. $\frac{60}{12}$

= 5 minutes (written as 5')



observations:

Least count of the Bevel Protractor _____ minutes

Tabular Column:

SL No.	Faces/Sides	Angles
1		
2		
3		
4		

Applications:

1. To measure the acute & obtuse angles in case of flat & circular objects with large radius.
2. In machining processes like production of flat surfaces.
3. For checking the _V' block, it is used.

Procedure:

1. Note down the least count of the Bevel Protractor.
2. Keep the work piece on the surface plate.
3. Fix the slide of Bevel Protractor to the Turret.
4. Keep one of the surfaces of the specimen on the working edge and rotate the turret. Remove the slide on to the other surface.
5. Fix the centre, after matching the both the faces and note down the reading.
6. Repeat the experiment for different faces

Results:

By using the bevel protractor, the taper angle of the given specimen is calculated.

MEASUREMENT OF TAPER ANGLE USING SINE BAR

Aim: To determine the taper angle of the given work piece and compare it with theoretical value by using sine bar.

Apparatus: Surface plate, sine bar, slip gauge sets, Vernier calliper, cleaning agent, tapered work piece, clean dry soft cloth, clamping devices etc.

Theory:

Sine bar is a precision instrument used along with slip gauges for accurate angle measurements 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.

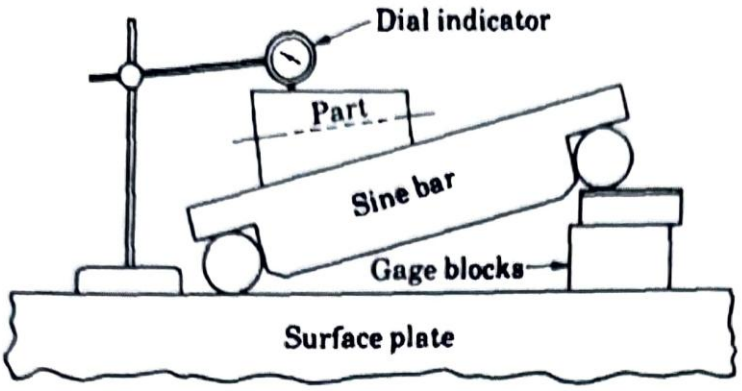
The straight bar are made of high carbon, high chromium, corrosion resistant steel and the surfaces are hardened, grounded and lapped. Ends of the straight bar are stepped so that the plugs can be screwed at each step. Plugs are the two rollers of same diameter fixed at a distance L between them and is called as length of the bar. This distance L is the centre to centre distance of plugs is which is generally 100, 200 and 300 mm and so on.

Use of Sine bar: The work piece whose angle is to be measured is placed on sine bar. Below one roller of sine bar, slip gauges are placed. Slip gauges are added till the work piece surfaces straight. Dial indicator is moved from one end of work piece till another end. Slip gauges are added till dial pointer does not move from zero position. The use of sine bar is based on the laws of **trigonometry**.

When sine bar set up is made for the purpose of angle measurement, sine bar itself forms hypotenuse of right angle triangle and slip gauges form the side opposite to the required angle. **Sin θ= (h/L),** Therefore θ= sin-1(h/L), Angle θ is determined by an indirect method as a function of sine so this device is called as sine bar. Sine bar is always used in conjunction with slip gauge and dial indicator for the measurement of angle.

The angle is defined as the opening between the two lines or planes, which meet at a point. So angle is a thing which can be generated very easily requiring no absolute standard. Sine bars are used in junction with slip gauges constitute a very good device for the precision measurement of angles. Since sine bars are used either to measure angle very accurately or for locating any work to a given angle within very close limit. Sine bars are used only for measuring and setting any angle of the object having flat surface. Sine bars are also used to

measure or set angle of the object not larger than the 450, if higher accuracy is demanded.



Observations:

1. Least count of vernier calliper = _____ mm
2. Least count of dial gauge = _____ mm
3. Distance between the centre of rollers & side bar L = 200 mm
4. Length of specimen (taper length), l = _____ mm

Tabular Column

SL No	Taper length of the specimen 'l' mm	Height for one side of the work piece 'h_1' mm	Height for another side of the work piece 'h_2' mm	Diff. of height dh = ($h_2 - h_1$)	App. Ht. of slip gauge Read. $H_{app.}$	Actual Ht. of slip gauge Read. H_{act}	Theoretical taper angle. θ_{th}	Actual taper angle. θ_{act}	Error
1									
2									

Calculations:

7) Height for one side of the work piece _h1' = ---------- mm

8) Height for another side of the work piece _h2' = ---------- mm

9) Difference in height dh = (h2- h1) = ---------- mm.

10) Approximate height of slip gauge used = Happ.

Happ. = dh x L ---------- mm

√ dh2+l2

11) Theoretical taper angle, □th = tan-1(dh/l) = ---------- Degrees

12) Actual taper angle, □act = [sin-1 (Hact)] /L = ---------- Degrees

13) Error □act - □the =---------- Degrees

Applications:

1. To measure and/ or set the angle accurately using a sine bar, the main requirement is that it must be accurate.

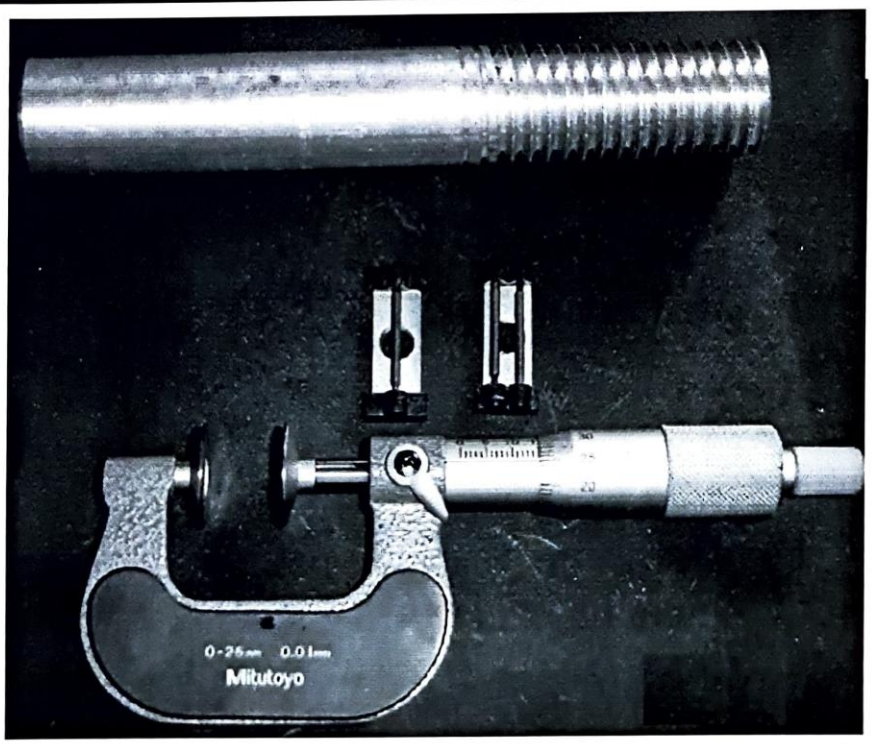
2. To check the flat surfaces in industry machine tools like lathe beds, milling machines columns, tables, apron & also saddle in lathe.

3. Rolling mills housing can be checked by sine bars.

Procedure:

1. Set the sine bar on the surface plate.
2. Measure the distance between rollers of center of sine bar.
3. Mark the position of the rollers on the surface plate which is advantage if the position of sine bar is changed.
4. The axial length of taper under test is noted by use of vernier calliper.
5. The work piece whose taper is required to be known is fixed on the upper surface of the sine bar by means of clamp and so positioned that easily access whole length of the taper to the dial gauge.
6. The dial gauge is fixed on its stand which in term is fixed on the slide way.
7. Note down the least count of the dial gauge used.
8. Adjust the slip gauge height on the taper to be measure in such a way that it easily takes slip on the smaller end and note down dial gauge reading at the entry end.
9. By sliding the dial gauge across the work piece length take reading of the dial gauge on other end.
10. Calculate approximate height of slip gauge required at smaller dimension end in order to become an upper surface of the work piece parallel to the reference plane.
11. Without altering the position of the roller place the slip gauge pile under the roller of small size end of the sine bar set up to equal approximate height.

THREAD MEASUREMENT



THREAD MEASUREMENT

AIM: To determine the effective diameter of the given threaded specimen using three wire method.

APPARATUS: Outside micrometer, wire set of two wires and one wire.

THEORY: Effective diameter of screw thread is defined as the diameter of an imaginary cylinder co-axial with the axis of the screw, and intersects the flanks of the threads in such a way as to make the widths of threads and widths of the spaces between the threads equal. It can also be defined as the diameter of the pitch cylinder is imagined as generated by a straight line parallel to the axis of the screw that straight line is then referred to as the pitch line. Along the pitch line the widths of the threads and widths of the spaces are equal on a perfect thread. This is the most important dimension as it decides the quality of the fit between the screw and nut.

M = measurement, E = Effective Diameter

Three wire method of measuring the effective diameter is an accurate method. In this three wires of known diameter are used. One wire on one side and two on the other side are used as show in fig-1

From fig-2

Let p = Pitch of the thread

M = Measurement over wires

= E + 2 Ac + 2r

Ac = Height of the centre of the wire from the pitch line

D = diameter of the wire = 2r

R = readius of the wire = d/2

From the fig-2 Ac = AD – CD

ΔABD is a right angle triangle.

$Sine\,x/2$ Sin x/2 = $\frac{AB}{AD} \Rightarrow AD = \frac{AB}{Sin\,x/2} = d/2\,case\,x/2$

ΔCDF is a right angle triangle

$\tan\frac{x}{2} = \frac{CF}{CD} : CF\ 1/4\ of pitch of the thread$

$$CD = \frac{1/4\,P}{\tan x/2} = \frac{p}{4}\cot\frac{x}{2}$$

$$\therefore AC = \frac{d}{2}\operatorname{cosec}\frac{x}{2} - \frac{p}{4}\cot\frac{x}{2}$$

Substituting the value of Ac in equation – 1

$$M = E + 2\left[\frac{d}{2}\cos ec\frac{x}{4} - \frac{p}{4}\cot\frac{x}{2}\right] + 2r$$

$$M = E + d\ \text{cosec}\ \frac{x}{2} - \frac{p}{2}\cot\frac{x}{2} + d$$

$$= E + d\left[1 + \cos ec\frac{x}{2}\right] - \frac{p}{2}\cot\frac{x}{2}$$

$$E = M + \frac{p}{2}\cot\frac{x}{2} - d\left[1 + \cos ec\frac{x}{2}\right]$$

This method ensures the alignment of micrometer anvil faced parallel to the thread axis.

Once the pitch, thread angle and wire diameter are known, and by measuring the value of M practically the effective diameter can be calculated.

PROCEDURE:

Take the thread specimen and find out the pitch by using a thread pitch gauge. After knowing the pitch, calculate the best wire size by using the formula.

If the thread is whit worth type best wire size = 0.5637p

If the thread is Metric type best wire size = 0.577p

Select the wires corresponding to the calculated value.

Keep the threaded specimen vertically on the surface plate. Stick two wires in adjacent threads with grease and the third wire diametrically opposite to the first two in the same groove. Apply the micrometer over wires and gently rock the anvils against wires. Note down the reading of the micrometer. Repeat the experiment at different positions along the gauge. Usually three or four readings are sufficient.

OBSERVATIONS:

Best wire size = mm

S.No.	Sleeve Reads (1)	Thimble reading (2)	Total reading M=(1)+(2)xL.C	Effective Diameter $E=M+\frac{p}{2}\cot\frac{x}{2}-d\left[1+\operatorname{cosec}\frac{x}{2}\right]$
1.				
2.				
3.				

PRECAUTIONS:

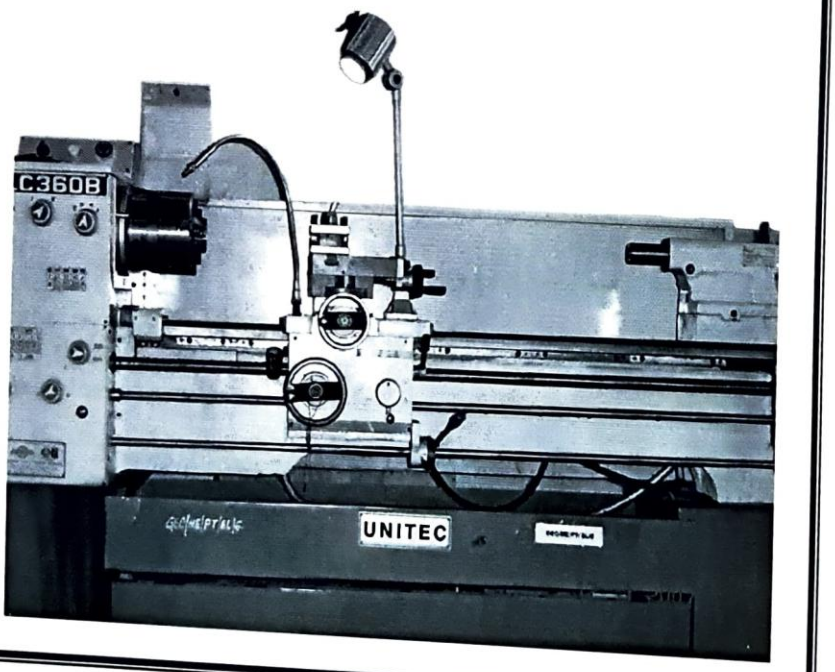
1. Do not apply excessive pressure on the micrometer
2. Axis of anvils of micrometer and the axis of screw plug gauge must be perpendicular to each other.

RESULT:

The effective diameter of the given thread specimen =

MACHINE TOOLS LAB

STEP TURNING AND TAPER TURNING ON LATHE



STEP TURNING AND TAPER TURNING ON LATHE

AIM:

To perform Step turning and Taper turning operations on the given work piece

MATERIAL REQUIRED:

Mild steel rod of 25 mm diameter and 100 mm long.

TOOLS REQUIRED:

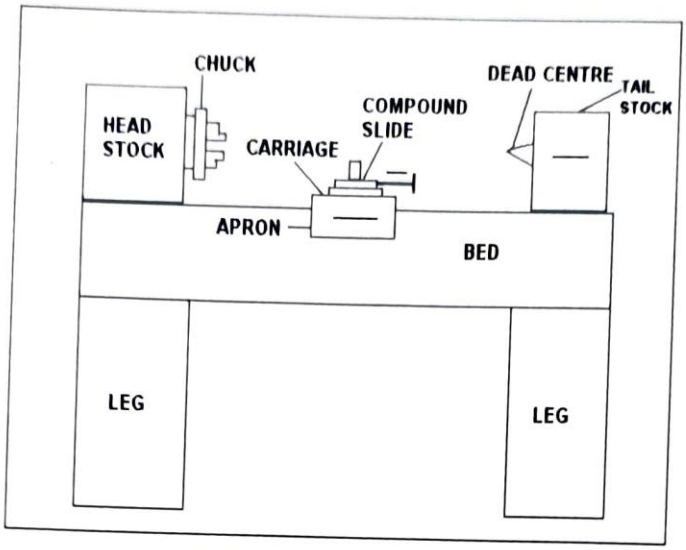
Vernier calipers, steel rule, spanner, chuck spanner, and H.S.S. single point cutting tool.

SPECIFICATION OF LATHE:

Length of bed	1390 mm
Width of bed	200 mm
Height of centers	165 mm
Admit between centers	700 mm
Lead screw pitch	4TPI
Power of the motor	1 h.p.

THEORY:

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the later help securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surfaces, at right angles to the axis of rotation. It can also produce tapers and bellows etc.



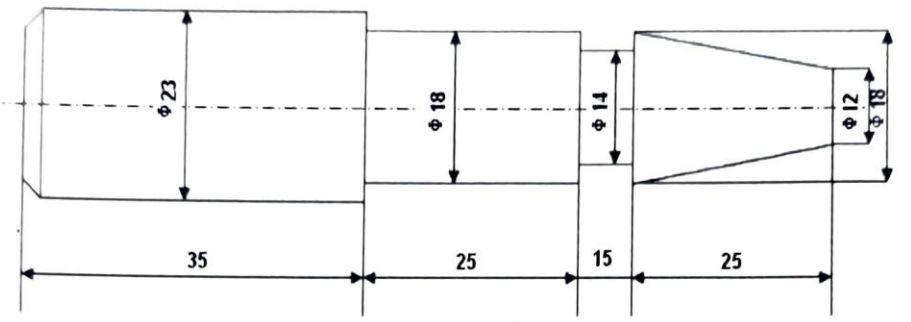
BLOCK DIAGRAM OF A LATHE

A lathe (shown in fig.) basically consists of a bed to provide support, a head stock, a cross side to traverse the tool, a tool post mounted on the cross slide. The spindle is driven by a motor through a gear box to obtain a range of speeds. The carriage moves over the bed guide ways parallel to the work piece and the cross slide provides the transverse motion. A feed shaft and lead screw are also provided to power the carriage and for cutting the threads respectively.

SEQUENCE OF OPERATIONS:

- Centering
- Facing
- Plain turning
- Chamfering
- Step turning
- Grooving
- Taper turning

PROCEDURE:



STEP TURNING AND TAPER TURNING

ALL DIMENSIONS ARE IN MM

- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post and centering operation is performed so that the axis of the job coincides with the lathe axis.
- Give the feed and depth of cut to the cutting tool
- Facing operation is performed from the center of the job towards outwards or from the circumference towards the center.
- Plain turning operation is performed until the diameter of the work piece reduces to 23 mm.
- Check the dimensions by using vernier calipers.
- Then chamfering is done on the 23mm diameter surface.
- Reverse the work piece in the chuck and facing operation is performed to reduce the length of work piece to the required dimensions.
- Again Plain turning operation is performed until the diameter of the work piece reduced to 18mm.

- Using V-cutting tool grooving operation is performed according to the given dimensions and finish the groove using parting tool.
- Swivel the compound slide to the required angle and taper turning operation by rotating the compound slide wheel.

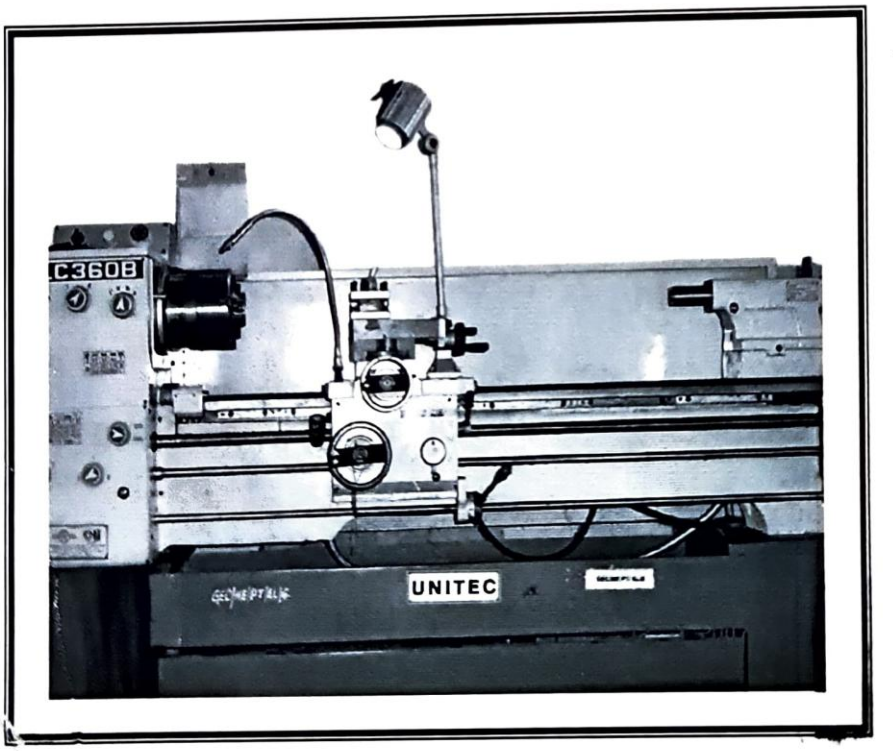
  The angle can be measured by using the formula $\text{Tan}\alpha = \frac{D - d}{2L}$
- Finally check the dimensions by using vernier calipers.

PRECAUTIONS:

- The work piece should be held rigidly in the chuck before operating the machine.
- Tool should be properly ground, fixed at correct height and properly secured, and work also be firmly secured.
- Before operating the machine see whether the job and tool is firmly secured in devices or not.
- Optimum machining conditions should be maintained.
- Chips should not be allowed to wound around a revolving job and cleared as often as possible
- Apply cutting fluids to the tool and work piece properly.

RESULT:

THREAD CUTTING AND KNURLING ON LATHE



THREAD CUTTING AND KNURLING ON LATHE

AIM:

To perform Thread cutting and Knurling operation on the given work piece.

MATERIAL REQUIRED:

Mild Steel rod of 25 mm diameter and 100 mm long

TOOLS REQUIRED:

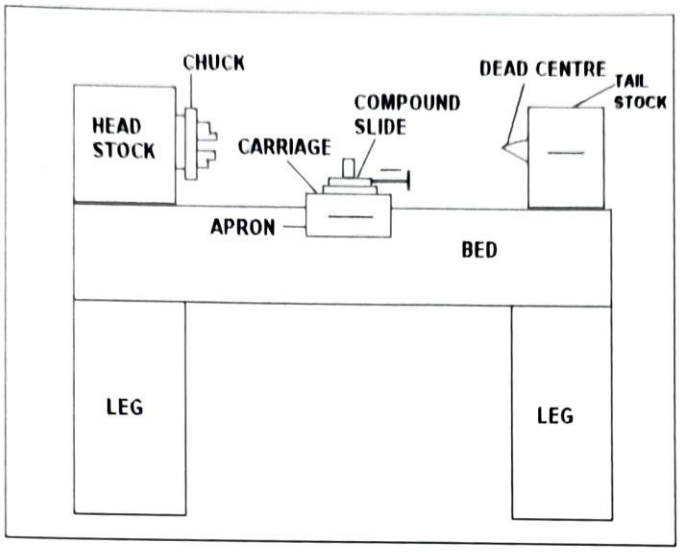
Vernier calipers, steel rule, spanner, chuck spanner, and H.S.S. single point cutting tool, parting tool and V- cutting tool.

SPECIFICATION OF LATHE:

Length of bed	1390 mm
Width of bed	200 mm
Height of centers	165 mm
Admit between centers	700 mm
Lead screw pitch	4TPI
Power of the motor	1 H.P.

THEORY:

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the later help securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surfaces, at right angles to the axis of rotation. It can also produce tapers and bellows etc.



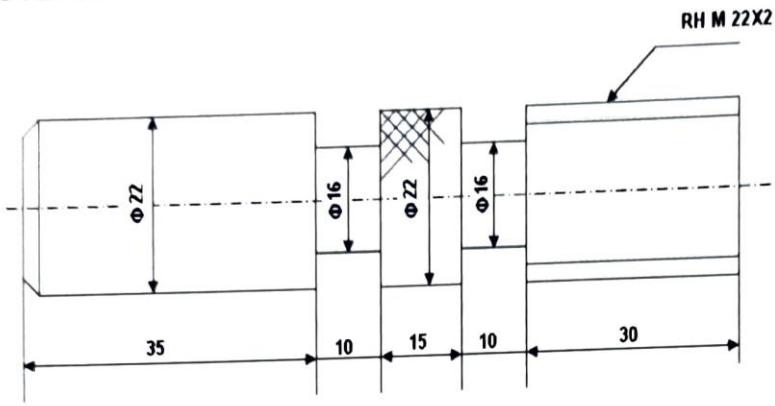
BLOCK DIAGRAM OF A LATHE

A lathe basically consists of a bed to provide support, a head stock, a cross side to traverse the tool, a tool post mounted on the cross slide. The spindle is driven by a motor through a gear box to obtain a range of speeds. The carriage moves over the bed guide ways parallel to the work piece and the cross slide provides the transverse motion. A feed shaft and lead screw are also provided to power the carriage and for cutting the threads respectively.

SEQUENCE OF OPERATIONS:

- Centering
- Facing
- Plain turning
- Chamfering
- Step turning
- Grooving
- Thread cutting
- Knurling

PROCEDURE:



THREAD CUTTING AND KNURLING

ALL DIMENSIONS ARE IN MM

- The work piece is fixed in a 3 – jaw chuck with sufficient overhang.
- Adjust the machine to run the job to required cutting speed.
- Fix the cutting tool in the tool post and centering operation is performed so that the axis of the job coincides with the lathe axis.
- Facing is performed by giving longitudinal depth of cut and cross feed.
- Perform plain turning operation until the diameter of the work piece reduced to 20mm.
- Chamfering operation is done according to the given dimensions.
- Then reverse the work piece in the chuck and plain turning operation is performed according to the given dimensions.
- Using V-cutting tool and parting off tool perform grooving operation to the required dimensions.
- Reduce speed of the spindle by engaging back gear and use Tumbler feed reversing mechanism to transmit power through the lead screw.

- And calculate the change gears for the required pitch to be made on the work piece.
- Using half nut mechanism perform thread cutting operation(right hand threading) according to the given dimensions and continues it until required depth of cut is obtained.
- At the same speed knurling operation is performed using knurling tool.
- For every operation check the dimensions using vernier calipers.

PRECAUTIONS:

- Before starting the spindle by power, lathe spindle should be revolved by one revolution by hand to make it sure that no fouling is there.
- Tool should be properly ground, fixed at correct height and properly secured, and work also be firmly secured.
- Chips should not be allowed to wind around a revolving job and cleared as often as possible.
- Before operating threading operation, V-tool should be properly ground to the required helix angle.
- Apply cutting fluids to the tool and work piece property.
- No attempt should be made to clean the revolving job with cotton waste.
- On hearing unusual noise, machine should be stopped.

RESULT:

DRILLING – TAPPING AND SURFACE GRINDING

DRILLING - TAPPING AND SURFACE GRINDING

AIM:

To perform drilling, tapping and surface grinding operations on the given work piece according to the given dimensions.

REQUIRED MATERIAL:

M.S. Flat of 45 x 45 x 10 mm^3.

REQUIRED TOOLS:

Vernier height gauge, v-block, Steel rule, dot punch, ball peen hammer and drill bits of diameters 4.5 mm, 8.5 mm & 14 mm and taps of diameter 5mm, 10mm and 16mm.

SEQUENCE OF OPERATIONS:

- Checking the raw material
- Marking and sawing
- Marking on the flat
- Drilling
- Tapping
- Grinding the corners
- Surface grinding

THEORY:

Drilling machine is one of the simplest, moderate and accurate machine tool used in production shop and tool room. It consist of a spindle which imparts rotary motion to the drilling tool, a mechanism for feeding the tool into the work, a table on which the work rests. It is considered as a single purpose machine tool since its chief function is to make holes.

RADIAL DRILLING MACHINE:

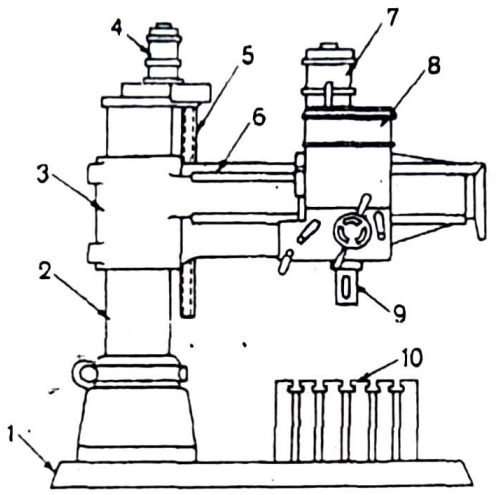


Figure Radial drilling machine

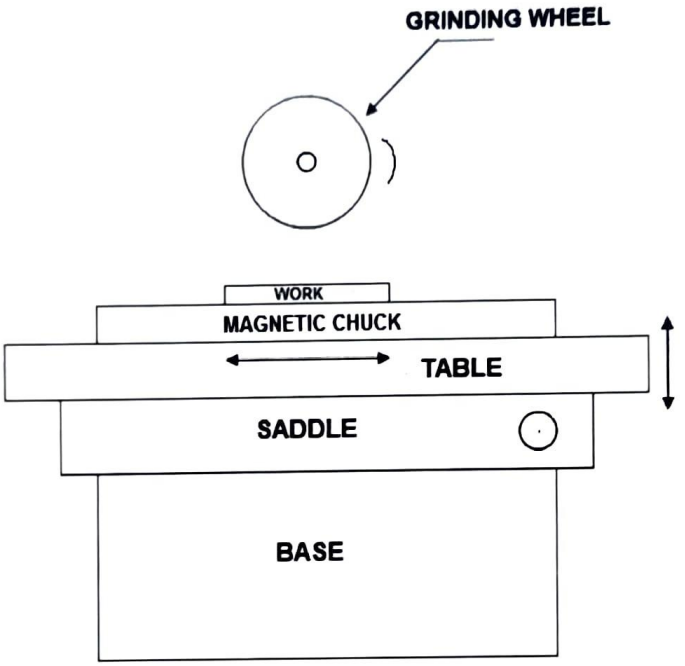
1. Base, 2. column, 3. Radial arm, 4. Motor for elevating the arm, 5. Elevating screw, 6. Guide ways, 7. Motor for driving the drill spindle, 8. Drill head, 9. Drill spindle, 10. Table

Radial drilling machine is intended for drilling medium to large and heavy work pieces. The machine consists of a heavy, round vertical column mounted on a large base. The column supports a radial arm which can be raised and lowered to accommodate work pieces of different heights. The arm may be swung around to any position over the work bed. The drill head containing the mechanism for rotating and feeding the drill is mounted on a radial arm and moved horizontally on the guide ways and clamped at any desired position. These three movements in a radial drilling machine when combined together permit the drill to be located at any desired point on a large work piece for drilling the hole. When several holes are drilled on a large work piece the position of the arm and the drill head is altered so that the drill spindle may be moved from one position to the other after drilling the hole with out altering the setting of the work. This versatility of the machine allows it to work on large work pieces.

Based on the type and number of movements possible the radial drills can be broadly grouped as:

- Plain Radial Drills
- Semi – Universal Radial Drills * Universal Radial Drills

SURFACE GRINDING MACHINE:



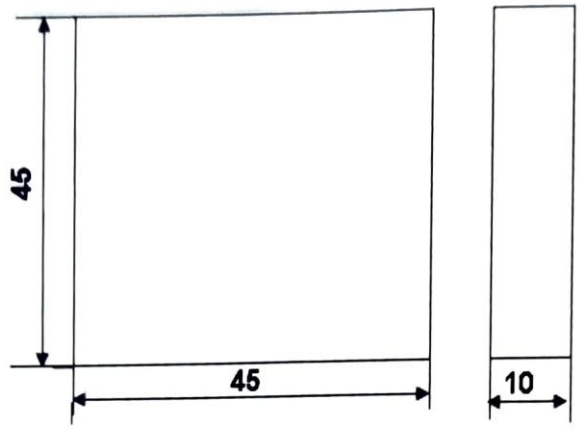
WORKING PRINCIPLE OF A SURFACE GRINDER

Surface grinders are primarily intended to machine flat surfaces, although irregular, curved or tapered surfaces can also be ground on them.

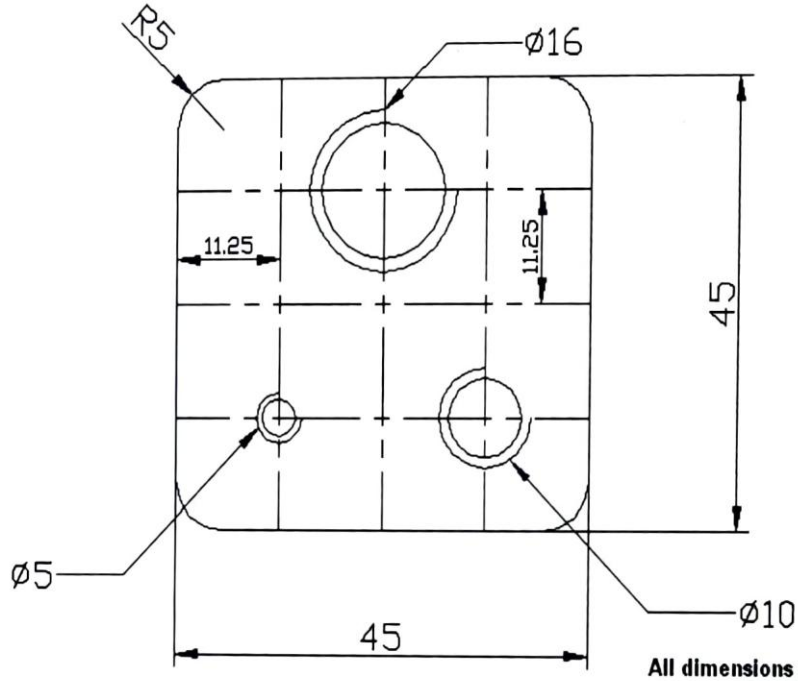
Horizontal spindle reciprocating table surface grinder: The working principle of the machine is illustrated by means of the diagram of relative movements in fig. A reciprocating table type surface grinder may have a horizontal spindle or a vertical spindle. The former will carry a straight wheel and the latter a cup type wheel. Cutting is done on the periphery of the wheel in case of horizontal spindle and on the revolving edge of the cup wheel on vertical spindle machines. The horizontal spindle machines are widely used in tool rooms. The work piece is usually held on a magnetic chuck on these machines. They are vastly used for grinding flat surfaces. The longitudinal feed to the work is given by reciprocating the table. For giving cross feed there are two methods. One is to mount the table on a saddle and give the cross feed by moving the saddle. Alternatively the cross feed can be given by moving the wheel – head in and out.

PROCEDURE:

Given Work Piece:



Required Work Piece:



All dimensions are in mm.

- The surface of the given work piece is the first smoothened by filing.
- Then chalk is applied on its surface and marking should be done as per the required dimensions.
- Cut the four corners of the work piece by using cold chisel.
- Grind the four corners of the work piece to the required shape by using bench grinder.

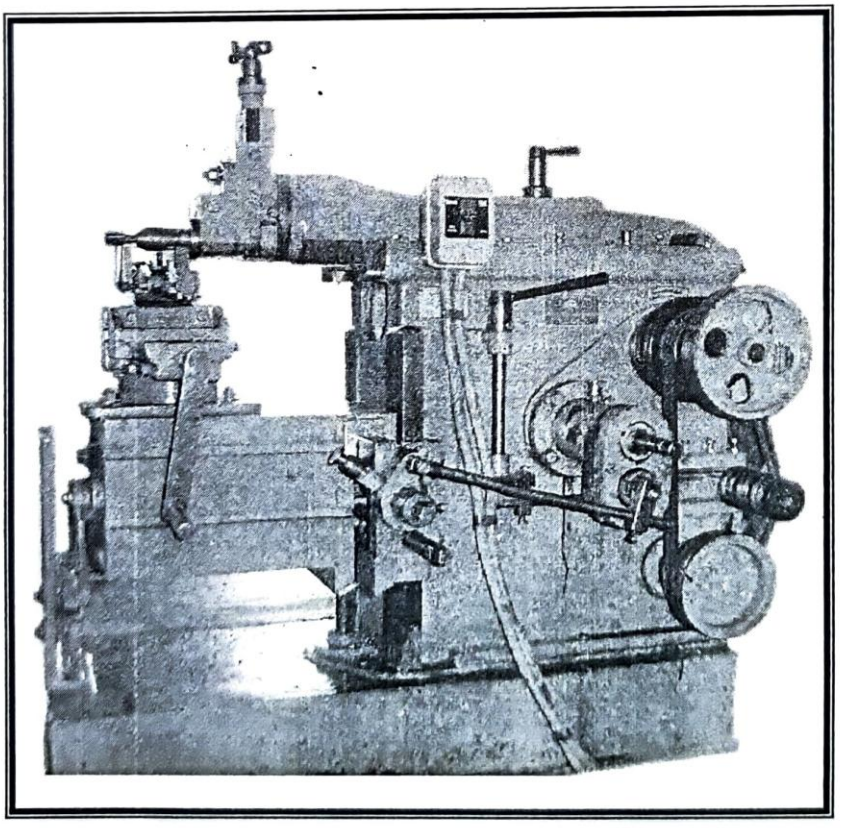
- Grind the four sides of the work piece.
- Drilling operation is performed to make different sizes of holes by using drilling machine.

PRECAUTIONS:

- Ensure cooling of work and blade while sawing the work through the supply of proper cutting fluids.
- Use properly sharpened drills for drilling to the right specifications.
- Work piece must be held rigidly on the drilling machine.
- Axis of spindle, adapter, and tool should be coinciding.
- The wheel should be correctly mounted in the spindle and enclose by a guard.
- The wheel speed chosen should be proper.
- Never grind on the side of a grinding machine.

RESULT:

SHAPER



SHAPER

AIM:

To prepare a square block of 22 mm side and 35 mm thick with key way in it from the given work piece by using Shaping machine.

MATERIAL REQUIRED:

M.S. Cylindrical rod of 32 mm diameter and 35 mm length.

TOOLS REQUIRED:

Steel rule, dot punch, Ball peen hammer, surface gauge and scriber, Vernier height gauge, V-block, surface plate and H.S.S.Single point cutting tool.

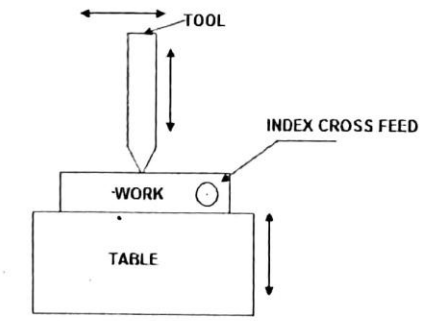
SPECIFICATION OF THE MACHINE:

Length of ram stroke	:	457 mm
Length of ram	:	914 mm
Max/min. distance from table to ram		406 x 89
Max. Vertical travel of tool slide		152 mm
Max. Swivel of tool head		60 degrees L & R
Power of the motor		2 H.P.

Theory:

Working Principle

The working principle of a shaper is illustrated in fig1.

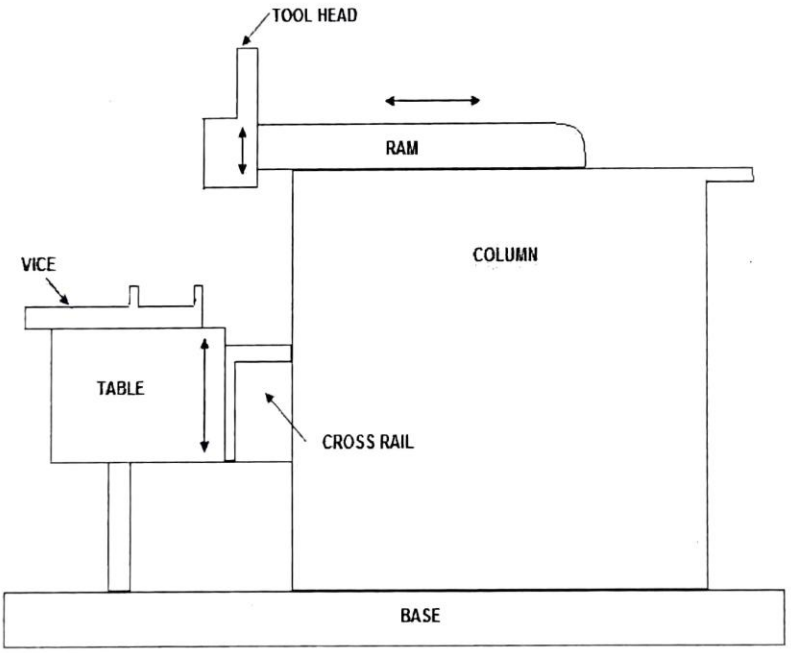


WORKING PRINCIPLE OF A SHAPER

In case of shaper; the job is rigidly held in a suitable device like a vice or clamped directly on the machine table. The tool is held in the tool post mounted on the ram of the machine. This ram reciprocates to and fro and in doing so makes the tool to cut the material in the forward stroke. No cutting of material takes place during the return stroke of the ram. Hence it is termed as idle stroke. However in case of a draw cut shaper the cutting takes place in the return stroke and the forward stroke is an idle stroke. The job is given an index feed in a direction normal to the line of action of the cutting tool.

Principal Parts of a Shaper

Principal parts of a shaper as illustrated in fig are the following.



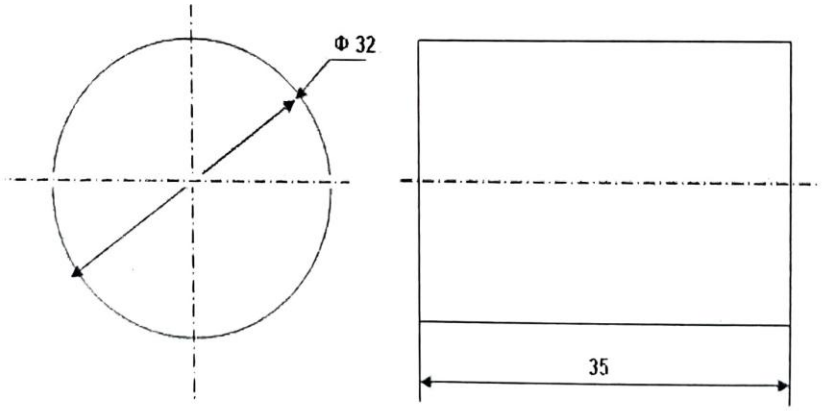
MAIN PARTS OF A SHAPER

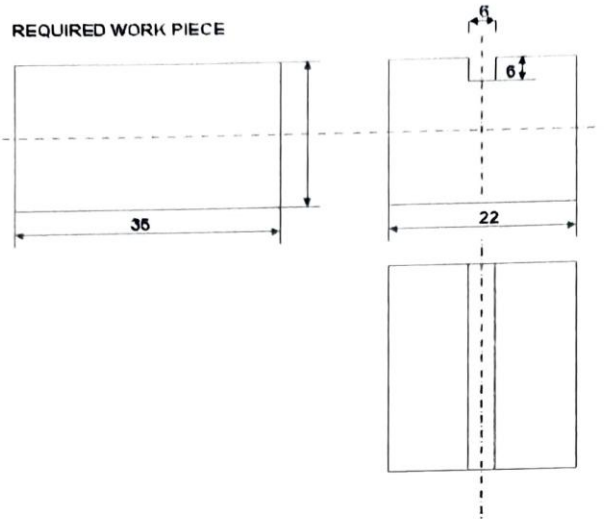
1. Base: It is a heavy and robust cast iron body which as a support for all the other parts of the machine which are mounted over it.

2. Column: It is a box type cast-iron body mounted on the base acts as housing for the operating mechanism of the machine and the electricals. It also acts as a support for other parts of the machine such as cross rail and ram etc.
3. Cross rail: It is a heavy cast iron construction attached to the column at its front on the vertical guide ways. It carries two mechanisms: one for elevating the table and the other for cross traversing of the table.
4. Table: It is made of cast iron and has a box type construction. It holds and supports the work during the operation and slides along the cross rail to provide feed to the work.
5. Ram: It is also an iron casting, semi circular in shape and provides with a ribbed construction inside for rigidity and strength. It carries the tool head and travels in dovetail guide ways to provide a straight line motion to the tool.
6. Tool head: It is a device in which is held the tool. It can slide up and down can be swung to a desired angle to set the tool at a desired position for the operation.
7. Vice: It is job holding device and is mounted on the table. It holds and supports the work during the operation.

PROCEDURE:

GIVEN WORK PIECE





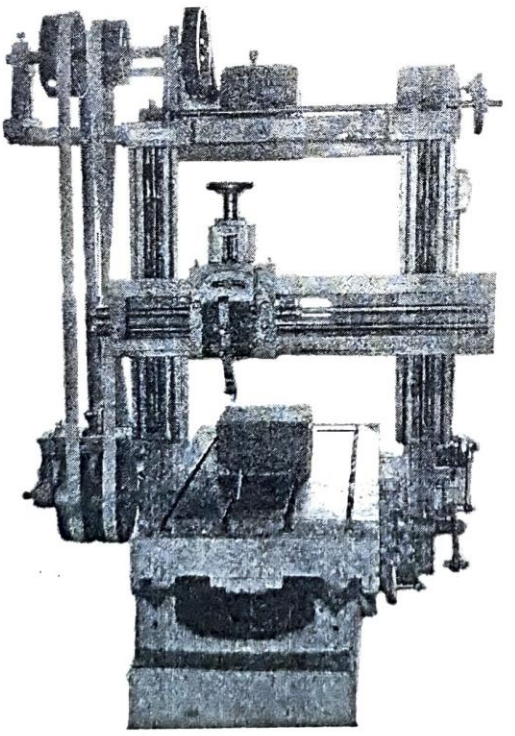
- The two ends of the work piece are first smoothened by filing and apply chalk on its surface.
- Place the work piece on the V-block and mark centre on the end face using surface gauge, scriber and Vernier height gauge.
- Mark square on the end face according to the required dimensions.
- By using dot punch made permanent indentation marks on the work piece.
- The tool is fixed to the tool post such that the tool movement should be exactly perpendicular to the table.
- The work piece is then set in the vice such that the tool is just above the work piece.
- Adjust the length of the stroke.
- Make sure that line of action of stroke should be parallel to the surface of the work piece.
- Give depth of cut by moving the tool and feed is given to the work piece during return stroke of the ram.
- Continue the process, until the required dimensions are to be obtained.
- Repeat the process for all the four sides.
- Finally make a key way on one side according to the given dimensions.

PRECAUTIONS:

- Marking should be done accurately.
- The work piece should be set securely and rigidly in the vice.
- Before starting a shaper make sure that the work vise, tool, and ram are securely fastened.
- Check that the tool and tool holder will clear the work and also the column on the return stroke.
- Always stand parallel to the cutting stroke and not in front of it.
- Never attempt to remove chips or reach across the table while the ram is in motion.
- Never attempt to adjust a machine while it is in rotation.
- Suitable feeds and depth of cut should be maintained uniformly.
- Apply cutting fluids to the tool and work piece properly.
- Always feed will be given to the tool in the backward stroke only.

RESULT:

PLANING MACHINE



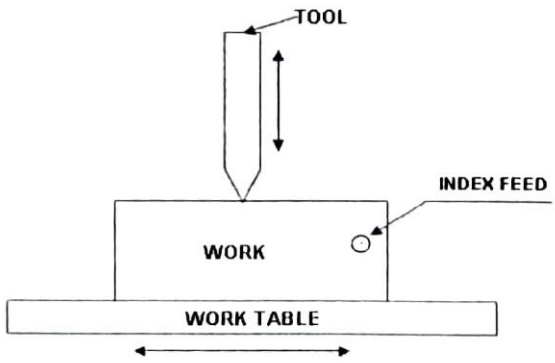
PLANING MACHINE

INTRODUCTION

Planing is one of the basic operations performed in machining work and is primarily intended for machining large flat surfaces. These surfaces may be horizontal, vertical or inclined. In this way, the function of a planning machine is quite similar to that of a shaper except that the former is basically designed to undertake machining of such large and heavy jobs which are almost impractical to be machined on a shaper or milling, etc. It is an established fact that the planning machine proves to be most economical so far as the machining of large flat surfaces is concerned. However, a palning machine differs from a shaper in that for machining, the work, loaded on the table, reciprocates past the stationary tool in a planer, whereas in a shaper the tool reciprocates past the stationary work.

WORKING PRINCIPLE OF A PLANER:

The principle involved in machining a job on a planer is illustrated in fig. Here, it is almost a reverse case to that of a shaper. The work is rigidly held on the work table or a platen of the machine. The tool is held vertically in the tool-head mounted on the cross rail. The work table, together with the job, is made to reciprocate past the vertically held tool. The indexed feed after each cut is given to the tool during the idle stroke of the table.



Working Principle of a Planer

SPECIFICATIONS:

Horizontal distance between two vertical housings:

Vertical distance between table top and the cross rail: 800mm

Maximum length of table travel: 1350mm

Length of bed: 2025mm

Length of table: 1425mm

Method of driving – Individual

Method driving table – Geared

H.P. of motor: 3 H.P. & 1 H.P.

STANDARD OR DOUBLE HOUSING PLANER:

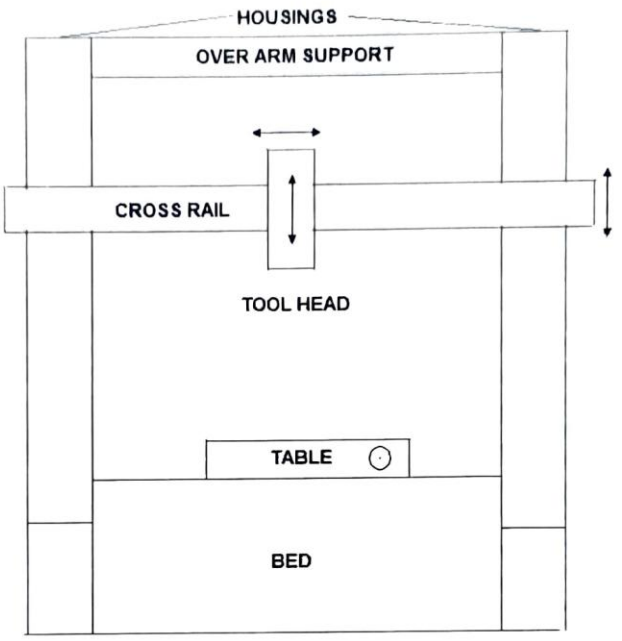
This is the most commonly used type of planer. It consists of two vertical housings or columns, one on each side of the bed. The housings carry vertical or scraped ways. The cross-rail is fitted between the two housings and carries one or two tool heads. The work table is mounted over the bed. Some planers may fit with side tool heads fitted on the vertical columns.

MAIN PARTS OF A PLANER

A planer consists of the following main parts as illustrated by means of a block diagram in fig.

- Bed
- Table
- Housings or columns
- Cross – rail
- Tool head
- Controls

These machines are heavy duty type and carry a very rigid construction. They employ high speeds for cutting but the size of work they can handle is limited to the width of their table i.e. the horizontal distance between the columns.



MAIN PARTS OF A PLANER

Extremely large and heavy castings, like machine beds, tables, plates, slides, columns, etc., which normally carry sliding surfaces like guide ways or dovetails on their longitudinal faces, are usually machined on these machines. Also because of long table and larger table travel, on either side of the columns, it is possible to hold a number of work pieces in a series over the bed length and machine them together. This will effect a substantial saving in machining time. Further because of no.of tool heads the surfaces can be machined simultaneously. This effects further reduction in machining time. Also because of high rigidity of high rigidity of the machine and robust design of the cutting tools heavier cuts can be easily employed, which leads to quicker metal removal and reduced machining time. Thus an overall picture emerges that the employment of this type of machine apart from its capacity to handle such heavy and large jobs which are difficult to be handled on other machines, leads to faster machining and reduced machining time and hence to economical machining. However considerable time is used in setting up a planer.

DRIVE MECHANISMS:

Four different methods are employed for driving the table of a planer. They are:

- Crank drive
- Belt drive
- Direct reversible drive
- Hydraulic drive

QUICK RETURN MECHANISM FOR PLANER TABLE:

Belt Drive:

Most of the common types of planers carry this system of drive for the quick return of their tables. The main features of this drive are shown in fig.

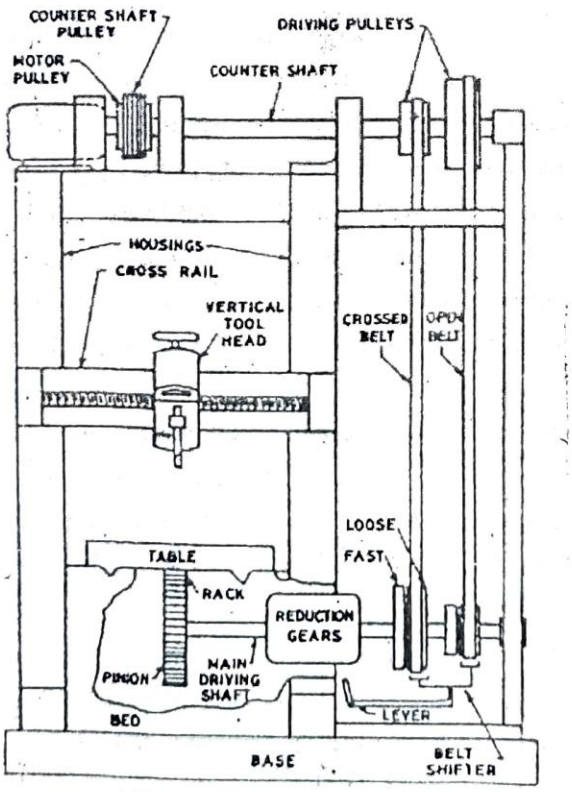
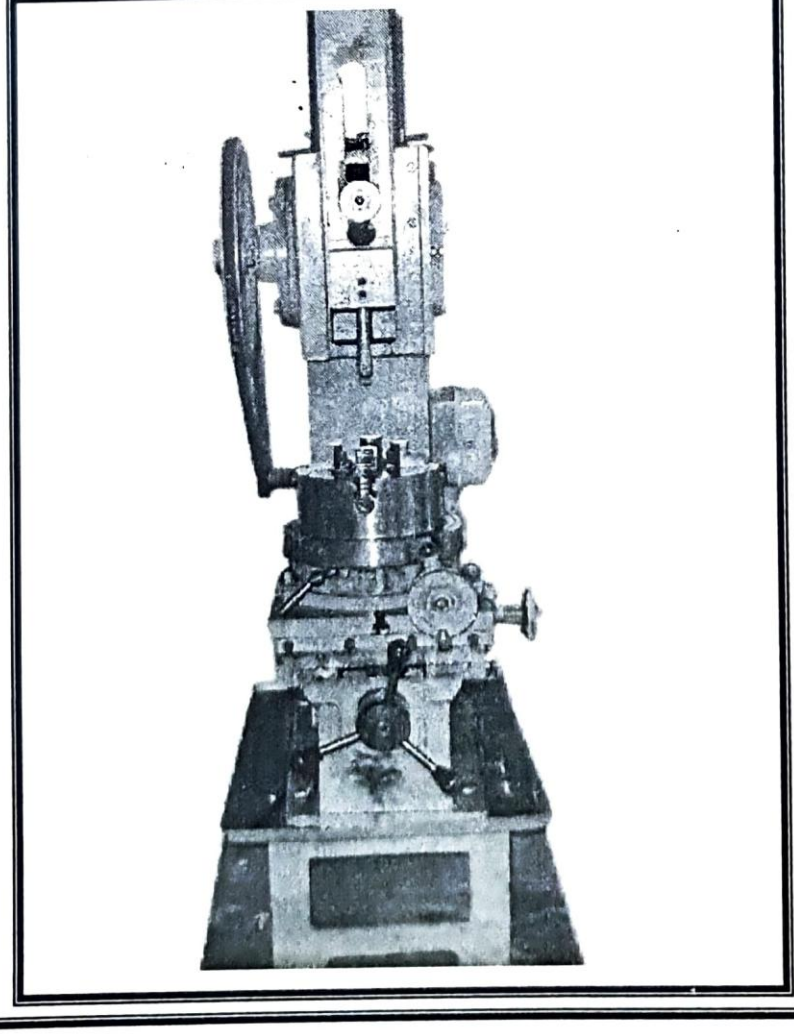


Fig. Belt drive for a planer.

SLOTTING



SLOTTING

AIM:

To Make internal splines, space 90^0 apart on the given hollow cylindrical work piece by using slotting machine.

REQUIRED MATERIAL:

M.S. Hollow Cylindrical work piece of 65 mm diameter and 70 mm length

REQUIRED TOOLS:

H.S.S. Cutting tool, Adjustable wrench, Scriber

SPECIFICATION OF THE MACHINE:

Stroke	150 mm
Rotary table	275 mm
Longitudinal Movement	200 mm
Cross Movement	200 mm
Power of the motor	1 h.p.

THEORY:

A Slotting machine or slotter has its won importance for a few particular classes of work. Its main use is in cutting different types of slots and it certainly proves to be most economical so far as this kind of work is concerned. Its other uses are in machining irregular shapes, circular surfaces and other premarked profiles, both internal as well as external. Its construction is similar to that of vertical shaper. Its ram moves vertically and the tool cuts during the downward stroke only.

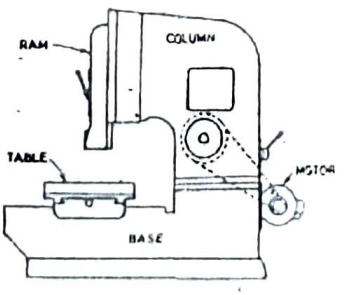


Fig. Main parts of a slotter.

Main Parts of a Slotter:

Base: It is heavy cast iron construction and is also known as bed. It acts as support for the column, the driving mechanism, ram, table and all other fittings. At its top it carries horizontal ways, along which the table can be traversed.

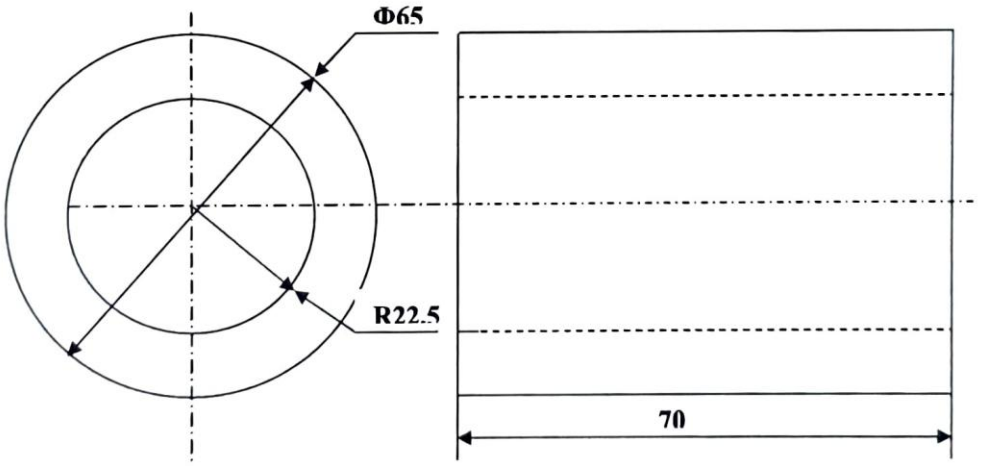
Column: It is another heavy cast iron body which acts as a housing for the driving mechanism. At its front carries vertical ways, along which the ram moves up and down.

Table: Usually a circular table is provided on slotting machines. In some heavy duty slotters, either rectangular or circular table can be mounted. On the top of table are provided T- slots to clamp the work or facilitate the use of fixtures etc.

Ram: It moves in vertical direction on the guide ways provided in front of the column. At its bottom, it carries the tool post in which the tool is held. The cutting action takes place during the downward movement of the ram.

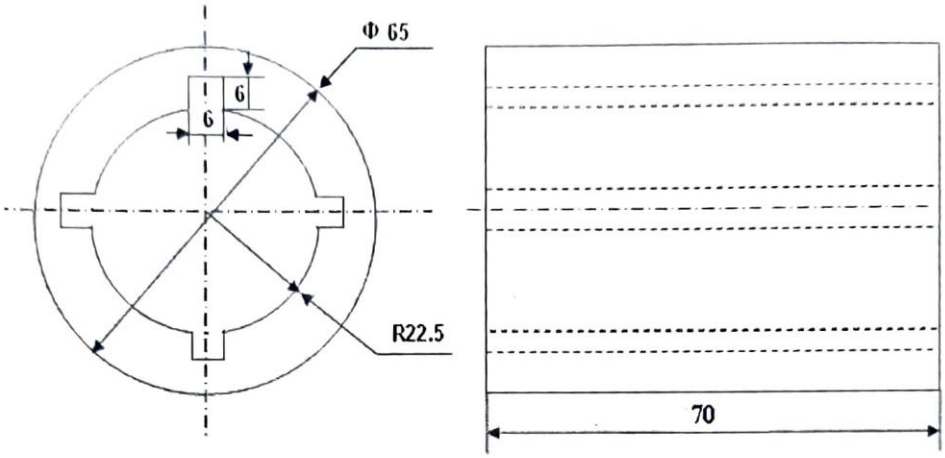
PROCEDURE:

GIVEN WORK PIECE



- The tool is fixed to the tool post such that the movement should be exactly perpendicular to the table.
- The work piece is then set in the vice such that the tool is just above the work piece.
- Adjust the length of the stroke of the ram.

REQUIRED WORK PIECE



ALL DIMENSIONS ARE IN MM

- Slotting operation is performed and make one slot on the work piece to the required dimensions.
- Then bring the tool to the initial position
- Rotate the work table by an angle 90^0 and continue the process for the second slot.
- Repeat the process for the remaining slots.

PRECAUTIONS:

- The work piece should be set securely and rigidly in the vice.
- Before starting the machine make sure that the work, vice, tool, and ram are securely fastened.
- Check that the tool and tool holder will clear the work and also clear the column on the return stroke.
- Make sure that the axis of the work piece is parallel to the line of action of tool.
- Never attempt to adjust a machine while it is in motion.
- Suitable feeds and depth of cut should be maintained uniformly.
- Always feed will be given to the work in the backward stroke only.

RESULT:

MILLING

MILLING

AIM:

Make a spur gear on the given work piece by using Milling Machine.

MATERIAL REQUIRED:

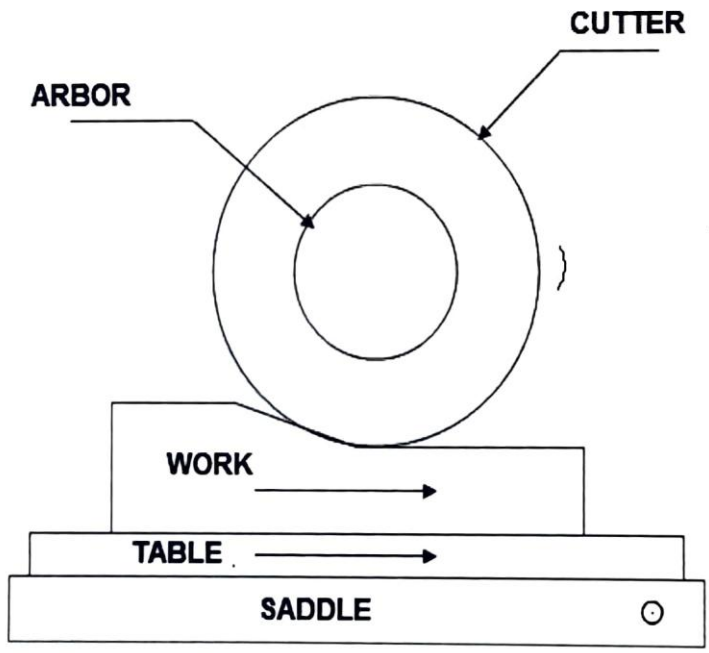
Wooden block of 60 mm diameter and 30 mm width

TOOLS REQUIRED:

Gear cutting tool or spur gear cutter, adjustable wrench and Universal dividing head.

THEORY:

Working principle in Milling:



WORKING PRINCIPLE OF MILLING

The working principle, employed in the metal removing operation on a Milling machine, is that the work is rigidly clamped on the table of the machine or held between centers, and revolving multi teeth cutter mounted either on a spindle or an arbor. The cutter revolves at a fairly high speed and the work fed

slowly past the cutter, as shown in fig. The work can be fed in a vertical, longitudinal or cross direction. As the work advances, the cutter-teeth remove the metal from the work surface to produce the desired shape.

With cylindrical cutters, the following two methods are used for performing milling operation.

Up or Conventional Milling: In this method of milling the cutter rotates in a direction opposite to that in which the work is fed.

Down or Climb Milling: In this method the direction of rotation of the cutter coincides with the direction of work fed as shown in fig.

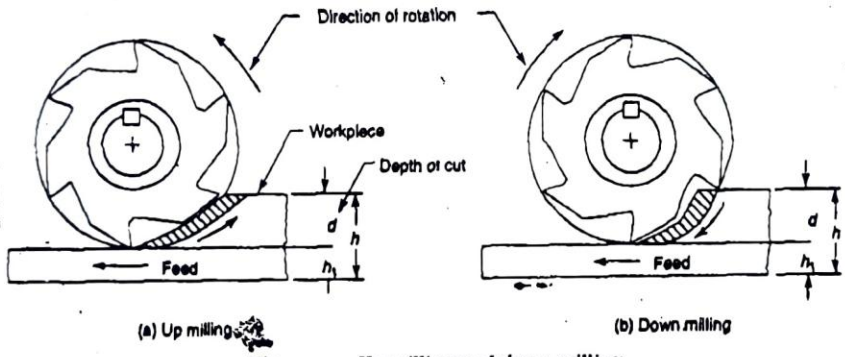
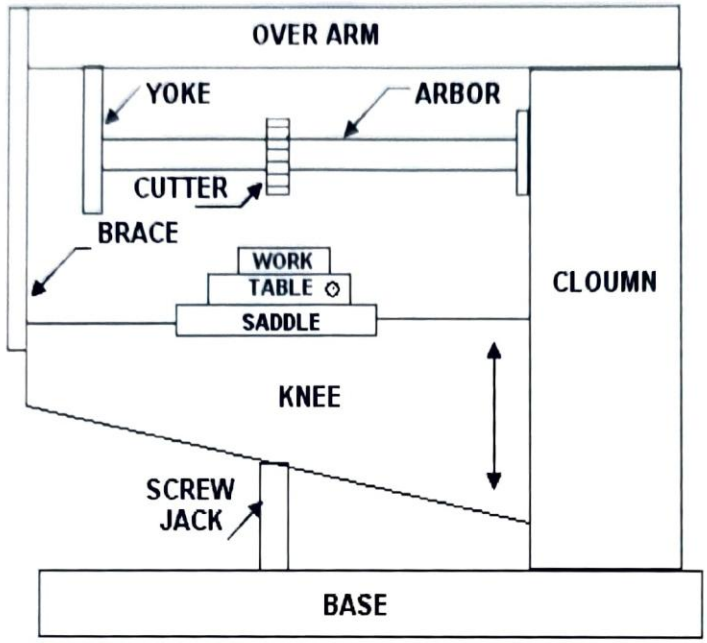


Fig. *Up milling and down milling*

The selection of a particular method depends upon the nature of work. Conventional milling is commonly used for machining castings and forgings since this method enables the cutter to dig-in and start the cut below the hard upper surface. Climb milling is particularly useful for finishing operations and small work such as slot cutting, milling grooves, slitting etc.

PLAIN OR HORIZONTAL MILLING MACHINE:



Main Parts of a Plain Milling Machine

Its principal parts are shown by means of a block diagram in fig. the vertical column serves as a housing for electricals, the main drive, spindle bearings, etc. the knee acts as a support for the saddle, work table and other accessories like indexing head, etc. over arm provides support for the yoke which in turn supports the free end of the arbor. The arbor carrying the cutter rotates about a horizontal axis. The table can be given straight motions in three directions; longitudinal, cross and vertical but cannot swiveled. For giving vertical movement to the table the knee itself, together with the whole unit above it slides up and down along the ways provided in front of the column. For giving cross movement to the table the saddle is moved towards or away from the column along with the whole unit above it. A brace is employed to provide additional support and rigidity to the arbor when a long arbor is used. Both hand and power feeds can be employed for the work.

CALCULATION FOR INDEXING:

Simple Indexing:

To find the Index Crank Movement, divide 40 by the number of divisions required on the work. The formula for index crank movement is given by

Index crank movement = $\frac{40}{N}$

Where N = Number of divisions required

Example:

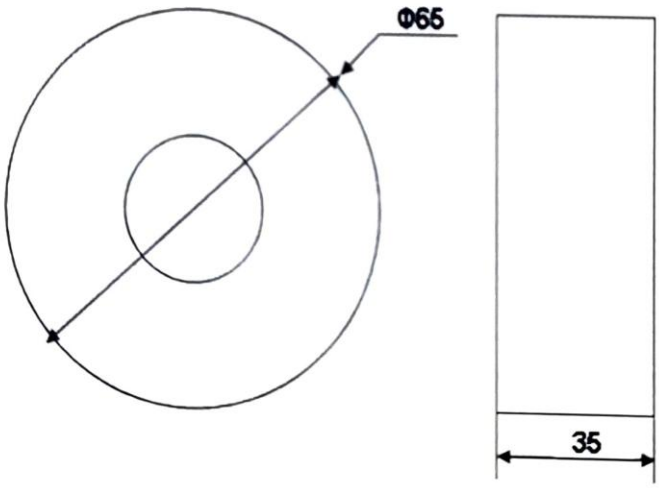
Number of teeth required on the given work piece = 16

Index crank movement = $\frac{40}{16} = 2\frac{8}{16}$

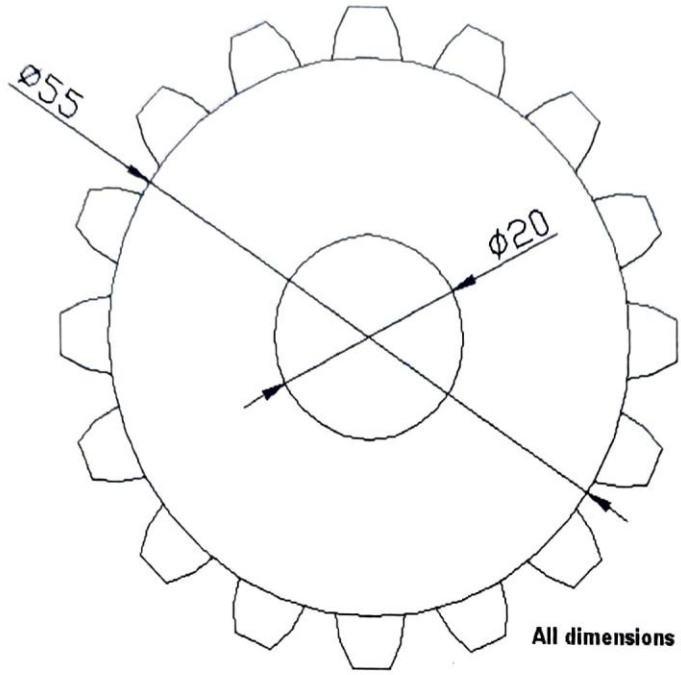
Thus for indexing, two complete turn and 8 holes in 16th hole circle of the index plate will have to be moved by the index crank.

PROCEDURE:

GIVEN WORK PIECE



REQUIRED WORK PIECE



All dimensions are in mm.

- The diving head and tailstock are bolted to the table.
- The cutter is mounted on arbor and is then centered accurately with the dividing head spindle axis by adjusting the position of the table in transverse direction. The alignment of the cutter with the work axis is checked by raising the table. (In this position, the centerline of the cutter must touch the center point of the tailstock). This assures the radial setting of the cutter relative to the gear blank.
- The index plate with suitable number of holes is selected and bolted to the dividing head. The position of the crank pin and sector arms are adjusted.
- First the table is raised till the cutter point touches the periphery of the work. Then the table is raised to the height equal to the tooth depth.
- Start the machine and give automatic feed by automatic feed mechanism to cut the first tooth of the gear.

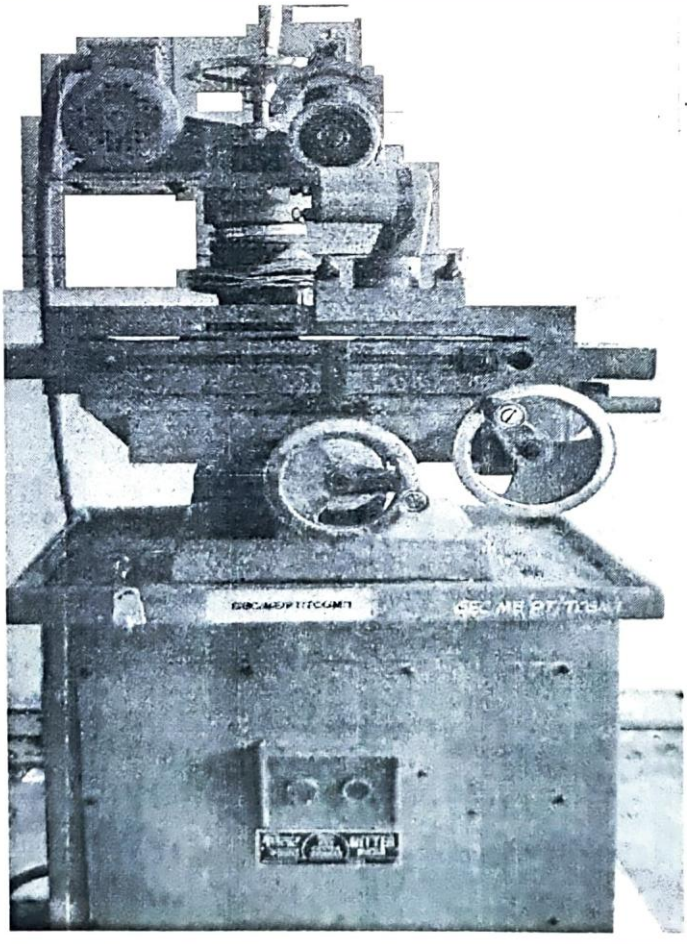
- Stop the machine and change the position of the crank pin by using simple indexing method, i.e., the work is indexed for machining the next tooth space.
- Repeat the above procedure for the remaining teeth.

PRECAUTIONS:

- Work piece must be fixed tightly between the centers of the indexing device.
- Suitable machining conditions should be maintained.
- Index crank must be rotated to the exact number of rotations.

RESULT:

GRINDING OF SINGLE POINT CUTTING TOOL



SINGLE POINT CUTTING TOOL

ELEMENTS OF A SINGLE POINT TOOL:

Shank: It forms the main body of a solid tool and it is this part of the tool which is gripped in the tool holder.

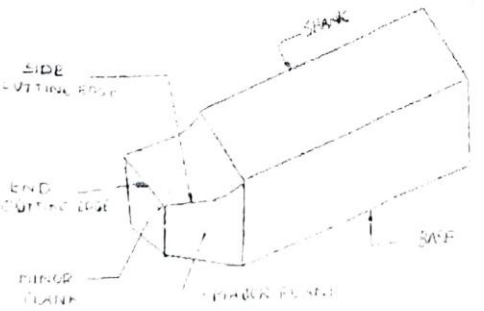
Face: It is the top surface of the tool between the shank and the point of the tool. In the cutting action the chip flows along this surface only.

Corner or point: It is the wedge shaped portion where the face and flank of the tool meet. It is the cutting part of the tool. It is also called nose

Flank: Portion of the tool which faces the work is termed as flank. It is the surface adjacent to and below the cutting edge when the tool lies in horizontal position.

Base: It is actually the bearing surface of the tool on which it is held in a tool holder or clamped directly in a tool post.

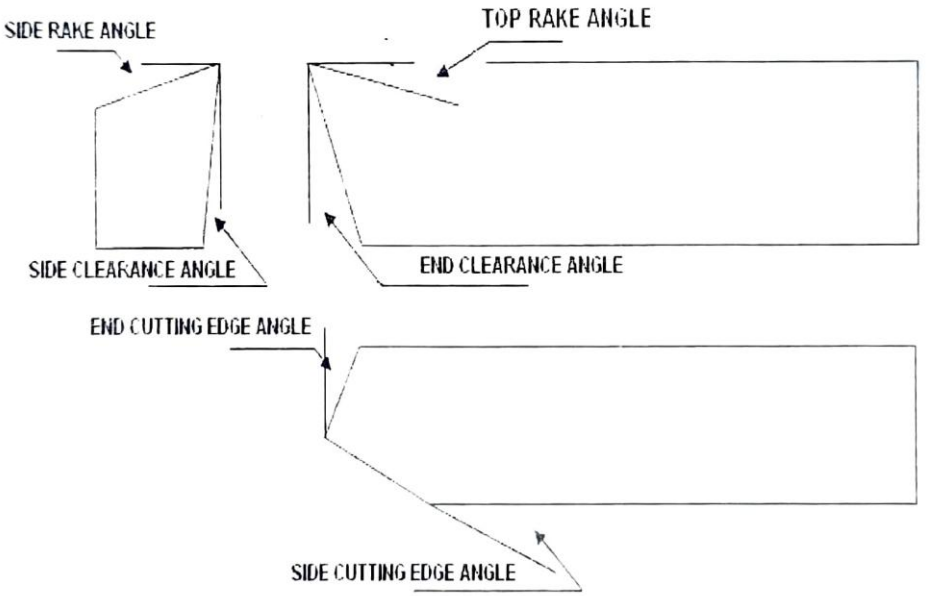
Cutting edge: It is the edge on the face of the tool which removes material from the work piece. The total cutting edge consists of side cutting edge and end cutting edge.



PRINCIPAL ANGLES OF A SINGLE POINT TOOL

Rake Angle: It is the angle formed between the face of the tool and a plane parallel to its base. The top face of the tool over which chip flows is known as the rake face. The angle which this face makes with the normal to the machined surface at the cutting edge is known as back rake angle and the angle between the face and a plane parallel to the tool base and measured in a plane perpendicular to both the tool holder and the side cutting edge is known as side

rake angle. These rake angles guide the chips away from the cutting edge, thereby reducing the chip pressure on the face and increasing the keenness of the tool so that less power is required for cutting. When the face of the tool is so ground that it slopes upwards from the point it is said to contain a negative rake. Using negative angles, directs the force back into the body of the tool away from the CE, which gives protection in the CE. The use of negative rake angle increases the cutting force and increases strength of the CE.



ANGLES OF A SINGLE POINT CUTTING TOOL

Side cutting angle: Angle between the side cutting edge and the side of the tool shank. Complimentary angle of SCEA is also called the approach angle. It is the angle which prevents interference as the tool enters the work material.

End cutting Edge angle:

The ECEA provides a clearance or relief to the trailing end of the cutting edge to prevent rubbing or drag between the machined surface and the trailing part of the CE. Only small angle is sufficient for this purpose. An angle of 8^{O} to 15^{O} has been found satisfactory in most cases.

Clearance angle: It is the angle formed by the front or side surfaces of the tool which are adjacent and below the cutting edge when the tool is held in a horizontal position. It is the angle between one of these surfaces and a plane normal to the base of the tool. When the surface considered for this purpose is in front of the tool i.e. just below the point, the angle formed is called front clearance and when the surface below the side cutting edge is considered the angle formed is known as side clearance angle. The purpose of providing front clearance is to allow the tool to cut freely without rubbing against the surface of the job and that of the side clearance to direct the acting thrust to the metal area adjacent to the cutting edge.

Relief angle: It is the angle formed between the flank of the tool and a perpendicular line drawn from the cutting point to the base of the tool.

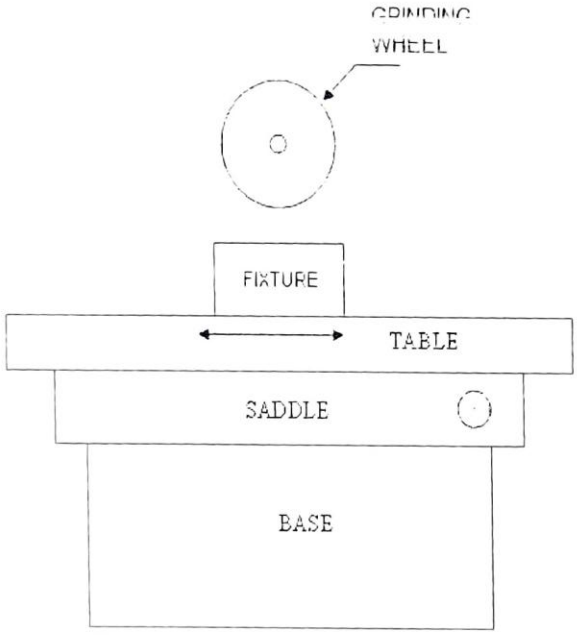
Nose Radius: If the cutting tip of a single point tool carries a sharp cutting point the cutting tip is weak. It is therefore highly stressed during the operation, may fail or lose its cutting ability soon and produces marks on the machined surface. In order to prevent these harmful effects the nose is [provided with a radius called nose radius. It enables greater strength of the cutting, tip, a prolonged tool life and a superior Surface finish on the work piece. Also as the value of this radius increases, a higher cutting speed can be used. But if it is too large it may lead to chaffer. So a balance has to be maintained.

TOOL AND CUTTER GRINDER:

Tool and Cutter grinders are used mainly to sharpen and recondition multiple tooth cutters like reamers, milling cutters, drills, taps, hobs and other types of tools used in the shop.

With various attachments they can also do light surface, cylindrical, and internal grinding to finish such items as jig, fixture, die and gauge details and sharpen single point tools. They are classified, according to the purpose of grinding into two groups:

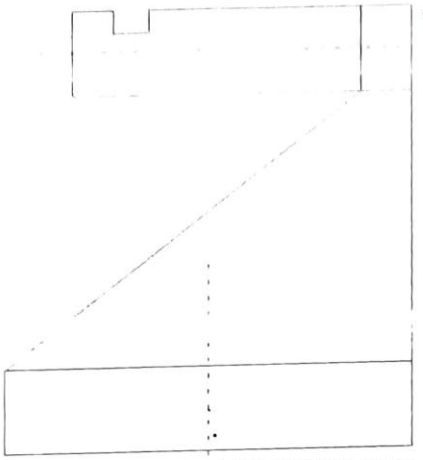
- Universal – tool and cutter grinders
- Single – purpose tool and cutter grinders



BLOCK DIAGRAM OF A TOOL AND CUTTER GRINDER

Universal tool and cutter grinders are particularly intended for sharpening of miscellaneous cutters. Single purpose grinders are used for grinding tools such as drills, tool-bits, etc in large production plants where large amount of grinding work is necessary to keep production tools in proper cutting condition. In addition tools can be ground uniformly and with accurate cutting angles.

SET UP OF FIXTURE FOR GRINDING TOOL:



SET UP FOR FIXTURE

POSITION	SHANK POSITION	ANGLE TO BE GROUND	SWIVEL OF HORIZONTAL BASE	SWIVLE OF VERTICAL BASE
1	Horizontal	End cutting edge angle	10^0 anti -clockwise	-----
	Horizontal	End clearance angle	-----	12^0 anti - clockwise
2	Vertical	Back Rake angle	------	10^0 anti clockwise from the right side of the operator
	Vertical	Side rake angle	10^0 clockwise from the operators view	----
3	Vertical	Side cutting edge angle	-----	12^0 clockwise from the right side of the operator
	Vertical	Side clearance angle	6^0 anti -clockwise	

EXPERIMENT SCHEDULE

VIDYA JYOTHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEEERING
SCHEDULE FOR SEC-A

CYCLE-I

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-I
Exp-1	25/06/19	22/07/19	16/07/19	09/07/19	02/07/19	06/08/19
Exp-2	02/07/19	25/06/19	22/07/19	16/07/19	09/07/19	
Exp-3	09/07/19	02/07/19	25/06/19	22/07/19	16/07/19	
Exp-4	16/07/19	09/07/19	02/07/19	25/06/19	22/07/19	
Exp-5	22/07/19	16/07/19	09/07/19	02/07/19	25/06/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-I
Exp-1	28/06/19	26/07/19	19/07/19	12/07/19	05/07/19	09/08/19
Exp-2	05/07/19	28/06/19	26/07/19	19/07/19	12/07/19	
Exp-3	12/07/19	05/07/19	28/06/19	26/07/19	19/07/19	
Exp-4	19/07/19	12/07/19	05/07/19	28/06/19	26/07/19	
Exp-5	26/07/19	19/07/19	12/07/19	05/07/19	28/06/19	

CYCLE-II

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-II
Exp -6	27/08/19	23/09/19	17/09/19	10/09/19	03/09/19	15/10/19
Exp -7	03/09/19	27/08/19	23/09/19	17/09/19	10/09/19	
Exp -8	10/09/19	03/09/19	27/08/19	23/09/19	17/09/19	
Exp -9	17/09/19	10/09/19	03/09/19	27/08/19	23/09/19	
Exp -10	23/09/19	17/09/19	10/09/19	03/09/19	27/08/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-II
Exp -6	30/08/19	27/06/19	20/06/19	13/06/19	06/09/19	18/10/19
Exp -7	06/09/19	30/08/19	27/06/19	20/06/19	13/06/19	
Exp -8	13/06/19	06/09/19	30/08/19	27/06/19	20/06/19	
Exp -9	20/06/19	13/06/19	06/09/19	30/08/19	27/06/19	
Exp -10	27/06/19	20/06/19	13/06/19	06/09/19	30/08/19	

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DEPARTMENT OF MECHANICAL ENGINEEERING
SCHEDULE FOR SEC-B

CYCLE-I

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-I
Exp-1	24/06/19	29/07/19	22/07/19	08/07/19	01/07/19	05/08/19
Exp-2	01/07/19	24/06/19	29/07/19	22/07/19	08/07/19	
Exp-3	08/07/19	01/07/19	24/06/19	29/07/19	22/07/19	
Exp-4	22/07/19	08/07/19	01/07/19	24/06/19	29/07/19	
Exp-5	29/07/19	22/07/19	08/07/19	01/07/19	24/06/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-I
Exp-1	20/06/19	25/07/19	11/07/19	04/07/19	27/06/19	08/08/19
Exp-2	27/06/19	20/06/19	25/07/19	11/07/19	04/07/19	
Exp-3	04/07/19	27/06/19	20/06/19	25/07/19	11/07/19	
Exp-4	11/07/19	04/07/19	27/06/19	20/06/19	25/07/19	
Exp-5	25/07/19	11/07/19	04/07/19	27/06/19	20/06/19	

CYCLE-II

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-II
Exp -6	19/08/19	30/09/19	16/09/19	02/09/19	26/08/19	14/10/19
Exp -7	26/08/19	19/08/19	30/09/19	16/09/19	02/09/19	
Exp -8	02/09/19	26/08/19	19/08/19	30/09/19	16/09/19	
Exp -9	16/09/19	02/09/19	26/08/19	19/08/19	30/09/19	
Exp -10	30/09/19	16/09/19	02/09/19	26/08/19	19/08/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-II
Exp -6	22/08/19	03/10/19	19/09/19	05/09/19	29/08/19	17/10/19
Exp -7	29/08/19	22/08/19	03/10/19	19/09/19	05/09/19	
Exp -8	05/09/19	29/08/19	22/08/19	03/10/19	19/09/19	
Exp -9	19/09/19	05/09/19	29/08/19	22/08/19	03/10/19	
Exp -10	03/10/19	19/09/19	05/09/19	29/08/19	22/08/19	

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DEPARTMENT OF MECHANICAL ENGINEEERING
SCHEDULE FOR SEC-C

CYCLE-I

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-I
Exp-1	26/06/19	24/07/19	17/07/19	10/07/19	03/07/19	07/08/19
Exp-2	03/07/19	26/06/19	24/07/19	17/07/19	10/07/19	
Exp-3	10/07/19	03/07/19	26/06/19	24/07/19	17/07/19	
Exp-4	17/07/19	10/07/19	03/07/19	26/06/19	24/07/19	
Exp-5	24/07/19	17/07/19	10/07/19	03/07/19	26/06/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-I
Exp-1	28/06/19	26/07/19	19/07/19	12/07/19	05/07/19	09/08/19
Exp-2	05/07/19	28/06/19	26/07/19	19/07/19	12/07/19	
Exp-3	12/07/19	05/07/19	28/06/19	26/07/19	19/07/19	
Exp-4	19/07/19	12/07/19	05/07/19	28/06/19	26/07/19	
Exp-5	26/07/19	19/07/19	12/07/19	05/07/19	28/06/19	

CYCLE-II

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-II
Exp -6	21/08/19	02/10/19	11/09/19	04/09/19	28/08/19	16/10/19
Exp -7	28/08/19	21/08/19	02/10/19	11/09/19	04/09/19	
Exp -8	04/09/19	28/08/19	21/08/19	02/10/19	11/09/19	
Exp -9	11/09/19	04/09/19	28/08/19	21/08/19	02/10/19	
Exp -10	02/10/19	11/09/19	04/09/19	28/08/19	21/08/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-II
Exp -6	23/08/19	04/10/19	13/09/19	06/09/19	30/08/19	18/10/19
Exp -7	30/08/19	23/08/19	04/10/19	13/09/19	06/09/19	
Exp -8	06/09/19	30/08/19	23/08/19	04/10/19	13/09/19	
Exp -9	13/09/19	06/09/19	30/08/19	23/08/19	04/10/19	
Exp -10	04/10/19	13/09/19	06/09/19	30/08/19	23/08/19	

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DEPARTMENT OF MECHANICAL ENGINEEERING
SCHEDULE FOR SEC-D

CYCLE-I

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-I
Exp-1	20/06/19	25/07/19	11/07/19	04/07/19	27/06/19	08/08/19
Exp-2	27/06/19	20/06/19	25/07/19	11/07/19	04/07/19	
Exp-3	04/07/19	27/06/19	20/06/19	25/07/19	11/07/19	
Exp-4	11/07/19	04/07/19	27/06/19	20/06/19	25/07/19	
Exp-5	25/07/19	11/07/19	04/07/19	27/06/19	20/06/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-I
Exp-1	24/06/19	29/07/19	22/07/19	08/07/19	01/07/19	05/08/19
Exp-2	01/07/19	24/06/19	29/07/19	22/07/19	08/07/19	
Exp-3	08/07/19	01/07/19	24/06/19	29/07/19	22/07/19	
Exp-4	22/07/19	08/07/19	01/07/19	24/06/19	29/07/19	
Exp-5	29/07/19	22/07/19	08/07/19	01/07/19	24/06/19	

CYCLE-II

	Batch-1	Batch-2	Batch-3	Batch-4	Batch-5	Mid-II
Exp -6	22/08/19	03/10/19	19/09/19	05/09/19	29/08/19	17/10/19
Exp -7	29/08/19	22/08/19	03/10/19	19/09/19	05/09/19	
Exp -8	05/09/19	29/08/19	22/08/19	03/10/19	19/09/19	
Exp -9	19/09/19	05/09/19	29/08/19	22/08/19	03/10/19	
Exp -10	03/10/19	19/09/19	05/09/19	29/08/19	22/08/19	

	Batch-6	Batch-7	Batch-8	Batch-9	Batch-10	Mid-II
Exp -6	19/08/19	30/09/19	16/09/19	02/09/19	26/08/19	14/10/19
Exp -7	26/08/19	19/08/19	30/09/19	16/09/19	02/09/19	
Exp -8	02/09/19	26/08/19	19/08/19	30/09/19	16/09/19	
Exp -9	16/09/19	02/09/19	26/08/19	19/08/19	30/09/19	
Exp -10	30/09/19	16/09/19	02/09/19	26/08/19	19/08/19	

DAY TO DAY EVALUATION

Sl.No	ROLL NO	Exp1_A	Exp1_B	Exp1_C	Exp1	Exp2_A	Exp2_B	Exp2_C	Exp2	Exp3_A	Exp3_B	Exp3_C	Exp3	Exp4_A	Exp4_B	Exp4_C	Exp4	Exp5_A	Exp5_B	Exp5	Average
1	17911A0301	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	2	5	11	-4	-4	13	13
2	17911A0302	5	-4	-4	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
3	17911A0303	-4	-4	5	13	-4	-4	-4	12	4	3	-4	11	4	-4	-4	12	-4	-4	12	12
4	17911A0304	5	-4	-4	11	5	5	5	13	3	5	-4	12	3	-4	5	12	5	5	12	12
5	17911A0305	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	2	5	11	-4	-4	13	13
6	17911A0306	3	3	5	11	3	5	5	13	3	-4	5	12	3	5	-4	12	3	-4	13	12
7	17911A0307	-4	-4	5	13	-4	-4	-4	12	4	2	5	11	4	5	5	12	-4	5	12	12
8	17911A0308	3	-4	-4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
9	17911A0311	-4	-4	5	13	-4	5	5	12	4	2	5	11	4	5	5	12	-4	3	13	12
10	17911A0312	5	5	5	15	5	5	-4	10	3	5	5	13	3	5	-4	12	5	-4	11	11
11	17911A0313	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
12	17911A0314	5	5	5	15	5	5	-4	10	3	5	5	13	3	5	-4	12	5	5	15	11
13	17911A0315	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
14	17911A0316	3	-4	-4	11	3	5	5	13	3	-4	5	12	3	-4	5	12	3	5	13	12
15	17911A0317	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
16	17911A0318	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	-4	5	12	3	-4	13	12
17	17911A0320	-4	-4	5	13	-4	5	5	14	5	5	5	15	5	-4	5	14	5	-4	14	14
18	17911A0321	5	-4	-4	11	5	5	5	13	3	5	-4	12	3	5	-4	12	5	-4	12	12
19	17911A0322	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
20	17911A0323	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
21	17911A0324	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
22	17911A0325	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
23	17911A0327	-4	-4	5	13	-4	5	5	14	5	5	5	15	5	-4	5	14	-4	5	14	14
24	17911A0328	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	5	-4	12	3	5	13	12
25	17911A0329	-4	-4	5	13	-4	-4	-4	12	4	2	5	11	4	3	5	12	-4	-4	12	12
26	17911A0330	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	5	-4	12	3	5	13	12
27	17911A0331	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
28	17911A0332	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	-4	5	12	3	-4	12	12
29	17911A0333	-4	-4	5	13	-4	-4	-4	12	4	3	-4	11	4	3	5	12	-4	-4	12	12
30	17911A0334	3	3	5	11	3	5	5	13	3	5	-4	12	3	-4	5	12	3	-4	12	12
31	17911A0335	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	2	5	11	-4	-4	13	13
32	17911A0336	3	-4	-4	11	3	5	5	13	3	-4	5	12	3	5	-4	12	3	-4	12	12
33	17911A0337	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	3	-4	11	-4	-4	13	13
34	17911A0338	3	-4	-4	11	3	2	5	10	3	3	5	11	3	-4	5	12	3	-4	11	11
35	17911A0339	-4	-4	5	13	-4	5	5	14	3	5	5	13	3	-4	5	14	-4	5	14	14
36	17911A0340	3	3	5	11	3	5	5	13	3	-4	5	12	3	5	-4	12	3	-4	12	12
37	17911A0341	-4	-4	5	13	-4	-4	-4	12	4	2	5	11	4	-4	-4	12	-4	-4	12	12
38	17911A0342	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
39	17911A0343	-4	-4	5	13	-4	-4	-4	12	4	2	5	11	4	3	5	12	-4	-4	12	12
40	17911A0344	5	5	5	15	5	5	-4	10	3	5	5	13	3	-4	5	12	5	-4	11	11
41	17911A0345	3	2	5	10	3	5	5	13	3	3	-4	10	3	3	5	11	3	3	11	11
42	17911A0346	3	-4	-4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
43	17911A0347	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	2	5	11	-4	-4	13	13
44	17911A0349	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	5	-4	12	3	-4	12	12
45	17911A0350	-4	-4	5	13	-4	-4	-4	12	4	5	-4	11	4	-4	-4	12	-4	-4	12	12
46	17911A0351	5	-4	-4	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
47	17911A0352	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	2	5	11	-4	-4	13	13
48	17911A0354	5	-4	-4	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
49	17911A0355	-4	-4	5	13	-4	3	5	12	4	2	5	11	4	-4	-4	12	-4	5	12	12
50	17911A0356	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	5	-4	12	3	-4	12	12
51	17911A0358	-4	-4	5	13	-4	-4	5	13	5	5	5	15	4	5	-4	11	-4	-4	13	13
52	17911A0359	3	-4	-4	11	3	5	5	13	3	5	-4	12	3	-4	5	12	3	-4	12	12

SNo	ROLL NO	Exp1_A	Exp1_B	Exp1_C	Exp1	Exp2_A	Exp2_B	Exp2_C	Exp2	Exp3_A	Exp3_B	Exp3_C	Exp3	Exp4_A	Exp4_B	Exp4_C	Exp4	Exp5_A	Exp5_B	Exp5	Average
53	1791IA0360	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
54	1791IA0361	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	12	12
55	1791IA0362	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
56	1791IA0363	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	5	12	12
57	1791IA0364	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
58	1791IA0365	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	12	12
59	1791IA0367	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	4	12	12
60	1791IA0368	3	4	4	11	3	2	5	10	3	4	4	11	3	4	5	12	3	5	11	11
61	1791IA0369	4	4	5	13	4	3	5	12	4	3	4	11	4	4	4	12	4	3	12	12
62	1791IA0371	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	12	12
63	1791IA0372	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
64	1791IA0373	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
65	1791IA0374	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
66	1791IA0375	3	4	4	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	12	12
67	1791IA0376	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
68	1791IA0377	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	4	12	12
69	1791IA0379	3	2	5	10	3	5	5	13	3	2	5	10	3	3	5	11	3	4	11	11
70	1791IA0380	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	5	4	14	14
71	1791IA0381	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	12	12
72	1791IA0382	5	4	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	14	14
73	1791IA0383	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
74	1791IA0384	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
75	1791IA0385	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	3	12	12
76	1791IA0386	3	4	4	11	3	3	4	10	3	3	5	11	3	5	4	12	3	4	11	11
77	1791IA0387	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
78	1791IA0388	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	14	14
79	1791IA0389	4	4	5	13	4	3	5	12	4	2	5	11	4	4	4	12	4	4	12	12
80	1791IA0390	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	12	12
81	1791IA0391	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
82	1791IA0392	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	5	12	12
83	1791IA0393	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	4	5	14	14
84	1791IA0394	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
85	1791IA0395	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	3	12	12
86	1791IA0396	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	12	12
87	1791IA0397	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	4	12	12
88	1791IA0398	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
89	1791IA0399	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
90	1791IA03A0	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
91	1791IA03A1	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	14	14
92	1791IA03A2	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
93	1791IA03A3	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	3	12	12
94	1791IA03A4	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
95	1791IA03A5	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	4	12	12
96	1791IA03A6	3	4	4	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	12	12
97	1791IA03A7	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
98	1791IA03AE	3	3	5	11	3	2	5	10	3	3	5	11	3	5	4	12	3	4	11	11
99	1791IA03AF	4	4	5	13	4	3	5	12	4	2	5	11	4	3	5	12	4	4	12	12
100	1791IA03B0	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
101	1791IA03B1	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	12	12
102	1791IA03B2	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
103	1791IA03B3	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	4	12	12
104	1791IA03B4	3	4	4	11	3	3	4	10	3	4	4	11	3	5	4	12	3	4	11	11
105	1791IA03B5	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13

SNo	ROLL NO	Exp1_A	Exp1_B	Exp1_C	Exp1	Exp2_A	Exp2_B	Exp2_C	Exp2	Exp3_A	Exp3_B	Exp3_C	Exp3	Exp4_A	Exp4_B	Exp4_C	Exp4	Exp5_A	Exp5_B	Exp5	Average
106	17911A03B6	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
107	17911A03B7	4	4	5	13	4	3	5	12	4	2	5	11	4	3	5	12	4	3	12	12
108	17911A03B8	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
109	17911A03B9	4	4	5	13	4	5	5	14	5	5	5	15	5	4	5	14	5	4	14	14
110	17911A03C1	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
111	17911A03C2	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	4	12	12
112	17911A03C3	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
113	17911A03C4	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	12	12
114	17911A03C5	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	12	12
115	17911A03C6	4	4	5	13	4	3	5	12	4	3	4	11	4	3	5	12	4	4	12	12
116	17911A03C7	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
117	17911A03C8	4	4	5	13	4	3	5	12	4	2	5	11	4	3	5	12	4	4	12	12
118	17911A03C9	3	4	4	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	12	12
119	17911A03D0	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
120	17911A03D1	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	14	14
121	17911A03D2	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
122	17911A03D3	3	3	5	11	3	2	5	10	3	4	4	11	3	4	5	12	3	3	11	11
123	17911A03D4	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	12	12
124	17911A03D5	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
125	17911A03D6	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	14	14
126	17911A03D7	5	4	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	14	14
127	17911A03D8	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	12	12
128	17911A03D9	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
129	17911A03E0	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
130	17911A03E1	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
131	17911A03E2	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
132	17911A03E3	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
133	17911A03E4	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	3	12	12
134	17911A03E5	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
135	17911A03E7	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
136	17911A03E8	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
137	17911A03E9	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	12	12
138	17911A03F0	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
139	17911A03F1	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	3	12	12
140	17911A03F2	3	3	5	11	3	5	5	13	3	5	4	12	3	5	4	12	3	4	12	12
141	17911A03F4	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
142	17911A03F5	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	5	4	14	14
143	17911A03F6	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
144	17911A03F7	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	12	12
145	17911A03F8	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
146	17911A03F9	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	12	12
147	17911A03G0	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	14	14
148	17911A03G1	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	12	12

SNo	ROLL NO	Exp1_A	Exp1_B	Exp1_C	Exp1	Exp2_A	Exp2_B	Exp2_C	Exp2	Exp3_A	Exp3_B	Exp3_C	Exp3	Exp4_A	Exp4_B	Exp4_C	Exp4	Exp5_A	Exp5_B	Exp5	Average
149	17911A05G2	4	4	5	13	4	5	5	12	4	2	5	11	4	5	5	12	4	5	12	12
150	17911A05G3	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
151	17911A05G4	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	4	12	12
152	17911A05G5	5	4	4	13	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
153	17911A05G6	4	4	5	13	4	4	4	12	4	5	4	13	4	4	4	12	4	4	12	12
154	17911A05G7	5	4	4	13	5	5	4	10	3	4	4	11	3	4	5	12	5	4	14	11
155	17911A05G8	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	14	14
156	17911A05G9	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
157	17911A05H0	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
158	17911A05H1	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
159	17911A05H2	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
160	17911A05H3	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
161	17911A05H4	4	4	5	13	4	5	5	13	4	2	5	11	4	4	4	12	4	4	12	12
162	17911A05H5	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	14	14
163	17911A05H8	4	4	5	13	4	5	5	12	4	5	4	13	4	4	4	12	4	4	12	12
164	17911A05H7	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
165	17911A05H8	4	4	5	13	4	4	4	12	4	2	5	11	4	5	5	12	4	5	12	12
166	17911A05H9	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	4	5	14	14
167	17911A05I0	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	4	12	12
168	17911A05I2	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
169	17911A05I3	4	4	5	13	4	4	4	12	4	2	5	11	4	5	4	12	4	5	12	12
170	17911A05I4	5	5	5	15	5	5	5	13	3	4	5	12	3	5	4	12	5	5	15	15
171	17911A05I5	4	4	5	13	4	5	5	12	4	2	5	11	4	5	5	12	4	5	12	12
172	17911A05I6	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
173	17911A05I7	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
174	17911A05I8	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
175	17911A05I9	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	5	12	12
176	17911A05J1	5	5	5	15	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
177	17911A05J2	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
178	17911A05J3	5	5	5	15	5	5	5	13	3	5	4	12	3	4	5	12	5	5	15	12
179	17911A05J5	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
180	17911A05J6	5	5	5	15	5	5	5	13	3	5	4	12	3	4	5	12	5	4	14	12
181	17911A05J7	4	4	5	13	4	5	5	12	4	2	5	11	4	4	4	12	4	4	12	12
182	17911A05J8	5	4	4	13	5	5	5	13	3	5	4	12	3	4	5	12	5	4	14	12
183	17911A05J9	4	4	5	13	4	5	4	13	5	5	5	15	4	5	5	14	4	5	14	14
184	17911A05K0	5	4	4	13	5	5	5	13	3	5	4	12	3	5	4	12	5	5	15	12
185	17911A05K1	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	15
186	17911A05K2	5	5	5	15	5	5	5	13	3	4	5	12	3	4	5	12	5	4	14	12
187	17911A05K3	4	4	5	13	4	4	4	12	4	2	5	11	4	5	5	12	4	5	12	12
188	17911A05K4	5	4	4	13	5	5	5	13	3	5	4	12	3	4	5	12	5	5	15	12
189	17911A05K5	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	15
190	17911A05K6	5	4	4	13	5	5	5	13	3	5	4	12	3	5	4	12	5	5	15	12
191	17911A05K7	4	4	5	13	4	5	5	12	4	5	4	13	4	4	4	12	4	4	12	12
192	17911A05K8	5	4	4	13	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	15
193	17911A05K9	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	15
194	17911A05L00	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
195	17911A05M1	5	5	4	14	5	5	5	13	3	2	5	10	3	5	5	13	5	5	15	11
196	17911A05M2	5	5	5	15	5	5	5	13	3	5	4	12	3	5	4	12	5	4	14	12
197	17911A05M3	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
198	17915A0342	5	4	4	13	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
199	18915A0301	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
200	18915A0302	5	4	4	13	5	5	5	13	3	4	5	12	3	5	4	12	5	5	15	12
201	18915A0303	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	13

SNo	ROLL NO	Exp1_A	Exp1_B	Exp1_C	Exp1	Exp2_A	Exp2_B	Exp2_C	Exp2	Exp3_A	Exp3_B	Exp3_C	Exp3	Exp4_A	Exp4_B	Exp4_C	Exp4	Exp5_A	Exp5_B	Exp5	Average
202	18915A0304	5	5	5	11	5	5	5	13	5	5	5	13	3	5	5	13	5	5	15	15
203	18915A0305	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	5	12	12
204	18915A0306	3	3	5	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	12	12
205	18915A0307	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
206	18915A0308	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
207	18915A0310	4	4	5	13	4	3	5	12	4	5	4	11	4	3	5	12	4	4	12	12
208	18915A0311	5	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	5	4	12	12
209	18915A0312	4	4	5	13	4	3	5	12	4	3	4	11	4	4	4	12	4	3	12	12
210	18915A0313	5	5	5	11	5	2	5	10	3	5	5	13	3	5	4	12	5	4	11	11
211	18915A0314	4	4	5	13	4	3	5	12	4	3	4	11	4	3	5	12	4	4	12	12
212	18915A0315	3	3	5	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	12	12
213	18915A0316	4	4	5	13	4	4	4	12	4	2	5	11	4	5	5	12	4	4	12	12
214	18915A0317	3	3	5	11	3	5	5	13	3	5	4	12	3	5	4	12	3	4	12	12
215	18915A0318	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
216	18915A0319	5	5	5	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
217	18915A0320	4	4	5	13	5	4	5	14	5	5	5	15	5	4	5	14	4	5	14	14
218	18915A0321	5	5	5	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
219	18915A0322	3	2	5	10	3	5	5	13	3	3	4	10	3	4	4	11	5	4	11	11
220	18915A0323	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
221	18915A0324	4	4	5	13	4	4	4	12	4	2	5	11	4	3	5	12	4	4	12	12
222	18915A0325	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
223	18915A0326	4	4	5	13	4	3	5	12	4	2	5	11	4	3	5	12	4	3	12	12
224	18915A0327	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	12	12
225	18915A0328	4	4	5	13	4	3	5	12	4	3	4	11	4	4	4	12	4	3	12	12
226	18915A0329	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
227	18915A0330	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	12	12
228	18915A0331	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	12	12
229	18915A0332	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
230	18915A0333	4	5	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	14	14
231	18915A0334	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
232	18915A0335	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
233	18915A0336	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	13	13
234	18915A0337	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
235	18915A0338	4	4	5	13	4	4	4	12	4	2	5	11	4	4	4	12	4	4	12	12
236	18915A0339	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
237	18915A0340	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	14	14
238	18915A0341	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	12	12
239	18915A0342	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
240	18915A0343	3	3	5	11	3	2	5	10	3	4	4	11	3	5	4	12	3	3	11	11
241	18915A0344	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	13	13
242	18915A0345	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	5	12	12
243	18915A0346	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	4	5	14	14
244	18915A0347	5	5	5	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
245	18915A0348	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	14	14
246	18915A0349	5	4	4	11	5	5	5	13	3	5	5	13	3	5	5	13	5	5	15	13
247	18915A0350	4	4	5	13	4	3	5	12	4	2	5	11	4	4	4	12	4	4	12	12
248	18915A0351	3	3	5	11	3	5	5	13	3	5	4	12	3	4	5	12	3	4	12	12
249	18915A0352	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	13	13
250	18915A0353	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	12	12

ROLL NO	Exp6_A	Exp6_B	Exp6_C	Exp6	Exp7_A	Exp7_B	Exp7_C	Exp7	Exp8_A	Exp8_B	Exp8_C	Exp8	Exp9_A	Exp9_B	Exp9_C	Exp9	Exp10_A	Exp10_B	Exp10_C	Exp10	Average
17911A0301	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0302	5	4	4	11	5	5	5	13	3	5	5	13	5	5	5	13	5	5	5	15	15
17911A0303	4	4	5	13	4	3	5	12	4	3	5	11	4	4	4	12	4	4	4	12	12
17911A0304	5	3	5	11	5	5	5	13	3	4	5	12	5	5	4	12	3	4	5	12	12
17911A0305	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0306	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0308	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0309	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0311	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0312	5	3	5	13	5	5	5	15	3	5	4	12	5	4	5	14	3	4	5	12	12
17911A0313	4	4	5	13	5	4	5	14	5	5	5	15	5	4	5	14	4	5	5	14	14
17911A0314	5	3	5	13	5	5	5	15	3	4	5	12	5	4	5	14	3	5	4	12	12
17911A0315	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0316	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0317	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0318	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0320	4	4	5	13	4	5	5	14	5	5	5	15	5	4	5	14	4	5	5	14	14
17911A0321	5	3	5	13	5	5	5	15	3	5	4	12	5	4	5	14	3	4	5	12	12
17911A0322	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0323	5	4	5	14	5	5	5	15	4	5	5	14	5	5	5	15	5	4	5	14	14
17911A0324	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0325	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0327	4	4	5	13	4	5	5	14	5	5	5	15	5	4	5	14	4	5	5	14	14
17911A0328	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	5	12	12
17911A0329	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0330	5	3	5	13	5	5	5	15	3	4	5	12	5	4	5	14	3	5	4	12	12
17911A0331	4	4	5	13	5	4	5	14	5	5	5	15	5	4	5	14	5	4	5	14	14
17911A0332	5	4	4	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	13
17911A0333	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0334	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	4	12	12
17911A0335	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0336	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	4	12	12
17911A0337	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0338	5	3	5	13	5	5	5	15	3	5	4	12	5	4	5	14	3	4	5	12	12
17911A0339	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0340	5	3	5	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	14
17911A0341	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0342	5	4	4	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	13
17911A0343	4	4	5	13	4	4	4	12	4	3	4	11	4	5	5	12	4	4	4	12	12
17911A0344	5	4	4	13	5	5	5	15	3	4	5	12	5	5	4	12	3	4	5	12	12
17911A0345	5	5	5	15	5	5	4	12	3	4	4	11	5	5	4	12	3	4	5	12	12
17911A0346	5	4	5	14	5	5	5	15	4	5	5	14	5	5	5	15	5	4	5	14	14
17911A0347	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0349	5	4	4	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	13
17911A0350	4	4	5	13	4	4	4	12	4	3	4	11	4	5	5	12	4	4	4	12	12
17911A0351	5	4	4	13	5	5	5	15	3	5	4	12	5	5	5	15	5	5	5	15	13
17911A0352	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0354	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0355	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0356	5	3	5	13	5	5	5	15	3	5	4	12	5	5	4	14	3	4	5	12	12
17911A0358	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0359	5	3	5	13	5	5	5	15	3	4	5	12	5	5	4	14	3	4	5	12	12

ROLL NO	Exp6_A	Exp6_B	Exp6_C	Exp6	Exp7_A	Exp7_B	Exp7_C	Exp7	Exp8_A	Exp8_B	Exp8_C	Exp8	Exp9_A	Exp9_B	Exp9_C	Exp9	Exp10_A	Exp10_B	Exp10_C	Exp10	Average
17911A0350	4	4	5	15	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	15	15
17911A0351	5	4	4	11	5	5	5	13	3	5	5	13	5	5	5	13	5	5	5	15	15
17911A0352	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A0353	5	3	5	11	5	5	5	13	3	5	4	12	5	4	5	12	3	4	5	12	12
17911A0354	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0355	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0357	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0358	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	4	5	12	12
17911A0359	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	4	4	12	12
17911A0371	5	3	5	11	5	5	5	13	3	5	4	12	5	5	4	12	3	4	5	12	12
17911A0372	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0373	4	5	5	14	5	5	5	15	4	5	5	14	5	5	5	13	5	4	5	14	14
17911A0374	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0375	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	4	12	12
17911A0376	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0377	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	4	12	12
17911A0379	5	5	5	15	5	5	4	12	3	4	4	11	5	4	5	12	3	4	5	12	12
17911A0380	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	5	14	14
17911A0381	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0382	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	5	14	14
17911A0383	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0384	5	3	5	13	5	5	5	15	4	5	5	14	5	5	5	15	5	5	5	15	14
17911A0385	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	5	12	12
17911A0387	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0388	5	4	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	5	14	14
17911A0389	4	4	5	13	4	4	5	13	5	5	5	15	4	4	5	13	4	5	5	14	14
17911A0390	5	4	4	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	15
17911A0391	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0392	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	5	12	12
17911A0393	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A0394	4	5	5	14	5	5	5	15	5	4	5	14	5	5	5	15	4	5	5	14	14
17911A0395	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0396	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0397	4	4	5	13	4	4	4	12	4	3	5	11	4	4	4	12	4	4	4	12	12
17911A0398	4	5	5	14	5	5	5	15	5	4	5	14	3	5	5	13	4	5	5	14	14
17911A0399	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A05A0	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A05A1	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A05A2	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A05A3	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	4	12	12
17911A05A4	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A05A5	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A05A6	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A05A7	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A05A8	3	3	5	11	3	5	5	13	3	4	5	12	3	4	5	12	3	5	4	12	12
17911A05A9	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A05B0	5	4	4	13	5	5	5	15	3	5	5	13	5	5	5	15	5	5	5	15	15
17911A05B1	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	4	12	12
17911A05B2	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A05B5	4	4	5	13	4	3	5	12	4	3	4	11	4	4	4	12	4	3	3	12	12
17911A05B4	3	3	5	11	3	5	5	13	3	5	4	12	3	5	4	12	3	4	5	12	12
17911A05B5	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	11	4	4	5	13	13

ROLL NO	Exp6_A	Exp6_B	Exp6_C	Exp6	Exp7_A	Exp7_B	Exp7_C	Exp7	Exp8_A	Exp8_B	Exp8_C	Exp8	Exp9_A	Exp9_B	Exp9_C	Exp9	Exp10_A	Exp10_B	Exp10_C	Exp10	Average
17911A03B6	4	5	5	14	5	5	5	15	5	4	5	14	5	5	5	13	5	4	5	14	14
17911A03B7	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	11	4	4	5	13	13
17911A03B8	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03B9	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A03C1	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03C2	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03C3	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	5	14	14
17911A03C4	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A03C5	3	3	5	11	5	5	5	15	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03C6	4	4	5	13	4	4	4	12	4	5	4	13	4	5	5	12	4	4	4	12	12
17911A03C7	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	5	14	14
17911A03C8	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A03C9	3	3	5	11	3	5	5	13	3	5	4	12	3	4	5	12	3	4	5	12	12
17911A03D0	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03D1	4	5	5	14	5	5	5	15	4	5	5	14	4	4	5	13	4	5	5	14	14
17911A03D2	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A03D5	3	4	4	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	4	12	12
17911A03D4	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03D5	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A03D6	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A03D7	4	5	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	5	14	14
17911A03D8	4	4	5	13	4	3	5	12	4	2	5	11	4	3	5	12	4	4	4	12	12
17911A03D9	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03E0	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A03E1	3	3	5	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	4	12	12
17911A03E2	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03E3	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03E4	4	4	5	13	4	4	4	12	4	3	4	11	4	3	5	12	4	4	4	12	12
17911A03E5	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A03E7	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A03E8	5	4	5	14	5	5	5	15	4	5	5	14	3	5	5	13	4	5	5	14	14
17911A03E9	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A03F0	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03F1	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03F2	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A03F4	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A03F5	4	5	5	14	5	5	5	15	5	4	5	14	4	4	5	13	5	4	5	14	14
17911A03F6	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03F7	3	3	5	11	3	5	5	13	3	5	4	12	3	4	5	12	3	4	5	12	12
17911A03F8	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A03F9	3	4	4	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	4	12	12
17911A03G0	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A03G1	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13

ROLL NO	Exp6_A	Exp6_B	Exp6_C	Exp6	Exp7_A	Exp7_B	Exp7_C	Exp7	Exp8_A	Exp8_B	Exp8_C	Exp8	Exp9_A	Exp9_B	Exp9_C	Exp9	Exp10_A	Exp10_B	Exp10_C	Exp10	Average
17911A0302	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0303	5	4	5	14	5	5	5	15	5	4	5	14	3	5	5	13	5	4	5	14	14
17911A0304	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0305	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0306	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0307	3	3	5	11	3	5	5	13	3	4	5	12	3	5	4	12	3	5	4	12	12
17911A0308	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0309	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0310	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0311	5	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0312	4	4	5	13	4	5	5	14	5	5	5	15	5	4	5	14	4	5	5	14	14
17911A0313	4	5	5	14	5	5	5	15	5	4	5	14	4	4	5	13	4	5	5	14	14
17911A0314	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	5	12	12
17911A0315	4	5	5	14	5	5	5	15	5	4	5	14	4	5	5	14	5	4	4	13	14
17911A0316	4	4	5	13	4	4	5	13	5	5	5	15	4	4	5	13	4	5	5	14	14
17911A0317	4	4	5	13	4	4	5	13	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A0318	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0319	4	4	5	13	4	4	5	13	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0320	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0321	5	4	5	14	5	5	5	15	5	4	5	14	5	5	5	15	5	4	5	14	14
17911A0322	5	5	5	15	5	4	5	14	5	4	5	14	5	4	5	14	5	4	5	14	14
17911A0323	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0324	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0325	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0326	4	4	5	13	4	3	5	12	4	3	4	11	4	4	4	12	4	4	4	12	12
17911A0327	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0328	4	4	5	13	4	3	5	12	4	3	5	11	4	4	4	12	4	4	4	12	12
17911A0329	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0330	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0331	3	4	4	11	3	5	5	13	3	4	5	12	3	5	4	12	3	4	5	12	12
17911A0332	4	4	5	13	5	4	5	14	5	5	5	15	5	4	5	14	5	4	5	14	14
17911A0333	5	4	5	14	5	5	5	15	5	4	5	14	4	4	5	13	4	5	5	14	14
17911A0334	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A0335	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0336	4	4	5	13	4	4	5	13	5	5	5	15	4	2	5	11	4	4	5	13	13
17911A0337	4	5	5	14	5	5	5	15	4	5	5	14	3	5	5	13	5	4	5	14	14
17911A0338	4	4	5	13	4	4	5	13	5	5	5	15	4	3	4	11	4	4	5	13	13
17911A0339	3	3	5	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0340	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0341	3	4	4	11	3	5	5	13	3	4	5	12	3	4	5	12	3	4	5	12	12
17911A0342	4	4	5	13	4	5	5	14	5	5	5	15	5	4	5	14	5	4	5	14	14
17911A0343	3	4	4	11	3	5	5	13	3	5	4	12	3	4	5	12	3	5	4	12	12
17911A0344	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0345	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0346	4	4	5	13	4	5	5	14	5	5	5	15	4	5	5	14	4	5	5	14	14
17911A0347	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0348	4	4	5	13	5	4	5	14	5	5	5	15	4	5	5	14	5	4	5	14	14
17911A0349	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0350	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
17911A0351	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
17911A0352	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
17911A0353	3	3	5	11	3	5	5	13	3	5	4	12	3	5	4	12	3	5	4	12	12

ROLL NO	Exp6_A	Exp6_B	Exp6_C	Exp6	Exp7_A	Exp7_B	Exp7_C	Exp7	Exp8_A	Exp8_B	Exp8_C	Exp8	Exp9_A	Exp9_B	Exp9_C	Exp9	Exp10_A	Exp10_B	Exp10_C	Exp10	Average
18915A0304	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	5	5	5	15	15
18915A0305	4	4	5	13	4	4	4	12	4	3	4	11	4	4	4	12	4	3	5	12	12
18915A0306	3	4	4	11	3	5	5	13	3	5	5	13	3	5	5	13	5	5	5	15	13
18915A0307	4	4	5	13	4	4	5	13	5	5	5	15	4	5	4	13	4	4	5	13	13
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RUBRICS FOR EVALUATION OF EXPERIMENTAT WORK

RUBRICS FOR LABORATORY EVALUATION

CRITERIA OF EVALUATION	POOR (1)	AVERAGE (2)	GOOD (3)	EXCELLENT (4)
Experimental procedure	Missing several important experimental details.	Missing some important experimental details	Important experimental details are covered, some minor details missing.	All experimental details are covered and well written in proper format.
Results: data, figures, graphs, tables, etc.	Figures, graphs, tables contain errors or are poorly constructed, have missing titles, captions or numbers, units missing or incorrect, etc.	Most figures, graphs, tables are fine. Some important or required features are missing.	All figures, graphs, tables are correctly drawn except for some minor issues in presentation.	All figures, graphs, tables are correctly drawn, are numbered and contain titles/captions.
Safety Measures/ Conclusions	Missing the important points of Safety Measures/ Conclusions	Conclusions regarding major points are drawn, but many are misstated, indicating a lack of understanding. Also the safety measures are vague.	All important conclusions have been drawn, could be better stated. Safety measures are stated.	All important conclusions have been clearly made and student shows good understanding. Safety measures are mentioned in proper format and followed.
Spelling, grammar, sentence structure	Frequent grammar and/or spelling errors, writing style is rough and immature	Occasional grammar/ spelling errors, generally readable with some rough spots in writing style	Less than 3 grammar/ spelling errors, mature, readable style	All grammar/ spelling correct and very well-written.

DIRECT ATTAINMEMT

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Aziz nagar Gate, C.B. Post, Hyderabad-500 075

DEPARTMENT OF MECHANICAL ENGINEERING

BATCH: 2017-21	**Course:MMT LAB/ A15320**			
A.Y.: 2019-20	**LABORATORY I INTERNAL EXAMINATION AWARD LIST (25M)**			
III B.Tech I Sem				
Sl. No.	**HT NO.**	**DTD (15M)**	**Exam (10M)**	**Total**
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DEPARTMENT OF MECHANICAL ENGINEERING

BATCH: 2017-21	**Course:MMT LAB/ A15320**			
A.Y.: 2019-20	**LABORATORY II INTERNAL EXAMINATION AWARD LIST (25M)**			
III B.Tech ISem				
Sl. No.	**HT NO.**	**DTD (15M)**	**Exam (10M)**	**Total**
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Vidya Jyothi Institute of Technology

(An Autonomous Institution)

(Accredited by NAAC & NBA, Approved by AICTE New Delhi & Permanently Affiliated to JNTUH)

Aziz nagar Gate, C.B. Post, Hyderabad-500 075

DEPARTMENT OF MECHANICAL ENGINEERING

BATCH: 2017-21	**Course:MMT LAB/ A15320**		
A.Y.: 2019-20	**LABORATORY INTERNAL & EXTERNAL EXAMINATION AWARD LIST**		
III B.Tech I Sem			
Sl. No.	**HT NO.**	**Internal Total (25M)**	**External Total (50M)**
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2	17911A0302	22	43
3	17911A0303	20	40
4	17911A0304	21	47
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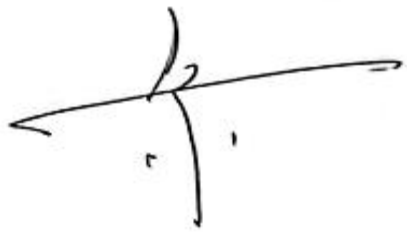
No of students attempted		**250**	**250**
No of students scored >= 60% Marks		**250**	**250**
% of students scored >= 60% Marks		**100**	**100**
ATTAINMENT LEVEL		**3.0**	**3.0**
Course Attainment (80% Direct + 20% Indirect)			
Direct Attainment		**3.00**	
Indirect Attainment		**2.60**	
Course Attainment		**2.92**	



COURSE EXIT SURVEY FOR INDIRECT ATTAINMENT

VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE INDIRECT ATTAINMENT REPORT

Batch: 2017-21
Year-Sem: III-II
Course: MMT LAB (A15320)
Course Indirect Attainment: 3.0
Students Participated: 166
Total Students: 250

Survey

Roll Number	CO1	CO2	CO3	CO4	CO5
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Anonymous	3	2	3	3	3

COURSE CLOSURE REPORT

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Regulation: R15
Academic Year: 2019-2020
Program: B.Tech (Mechanical Engineering)
Year/Sem: III/ I
Course Name: Metrology and Machine Tool Lab
Course Code: A15320
Contact Hours: 3Lectures/1 Credit
No. of Students: 250

No. of lecture classes taken	**15**
No. of tutorial classes taken	**2**
Course delivery modes	Lectures, Demonstration
Technology utilization	Power Point / OHP Slides
Assessment Tools	Internal Mid Examinations, Assignments

OVERALL ATTAINMENT (80% DIRECT + 20% INDIRECT)	
DIRECT	3.00
INDIRECT	2.60
OVERALL ATTAINMENT	2.92