MAHA BARATHI ENGINEERING COLLEGE

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DEPARTMENT OF MECHANICAL ENGINEERING

Lab Name : MANUFACTURING TECHNOLOGY LABORATRY

Lab Code : ME3382

Year / Sem : II/III

Regulation : 2021

Department : MECHANICAL ENGINEERING

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ME3382 MANUFACTURING TECHNOLOGY LABORATORY **L T P C**

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COURSE OBJECTIVES:

1. To Selecting appropriate tools, equipment's and machines to complete a given job.
2. To Performing various welding process using GMAW and fabricating gears using gear making machines.
3. To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Generating gears using gear shaping machine.
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in milling machine.
14. Cutting force calculation using dynamometer in lathe machine.

TOTAL: 60 PERIODS

CONTENTS

Expt. No. 01 **STUDY OF WELDING**

Aim:

To understand the basic concepts of welding by carrying out simple exercises relevant to its principles

Introduction:

Welding is the progress of joining two metal plates using a joining material by heat. It is commonly used to join metal plates in making boilers, vessels, furniture's, automobile parts, etc.

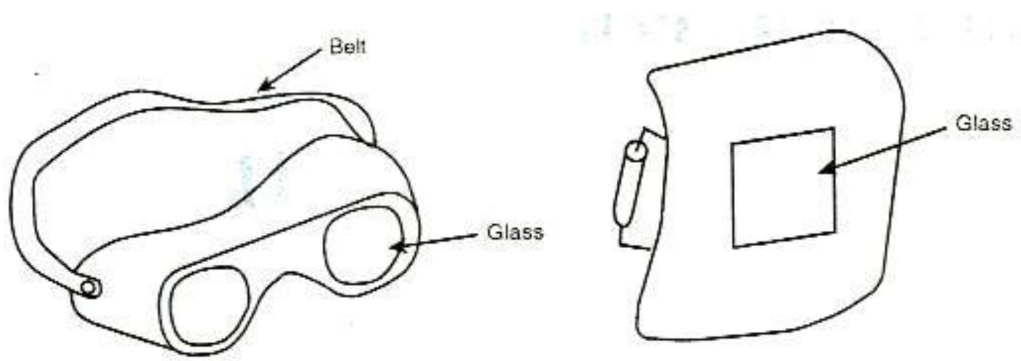
Safety equipment's and tools:

Welding goggles:

Goggles with glasses are used to protect the eyes of the eyes of the welder from the light sparks produced during welding.

Face shield:

A face shield is also used to protect the eyes of the welder from the light sparks produced during welding. It is normally held in hand.

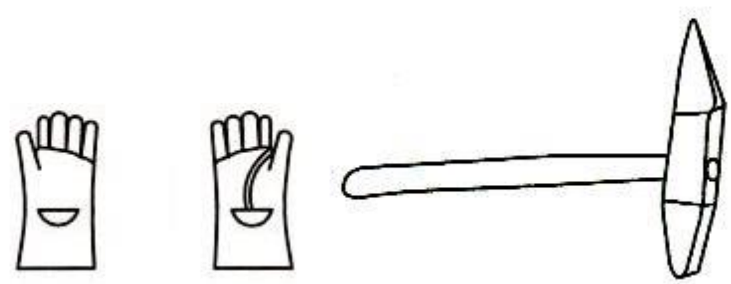


Hand gloves:

It is used to protect the hands of the welder from the effect of ultra violet rays, infra red rays, heat and sparks.

Chipping Hammer:

A chipping hammer is used to remove slags which from during welding.

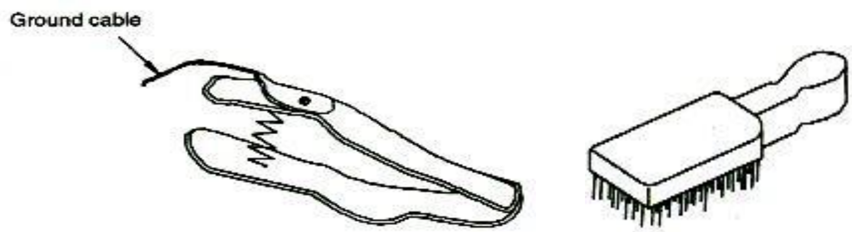


Ground Clamp:

It is connected to the end of the ground cable. It is normally clamped to the welding table or the job itself to complete the electric circuit.

Wire brush:

The wire brush is used to clean the surface to be welded.



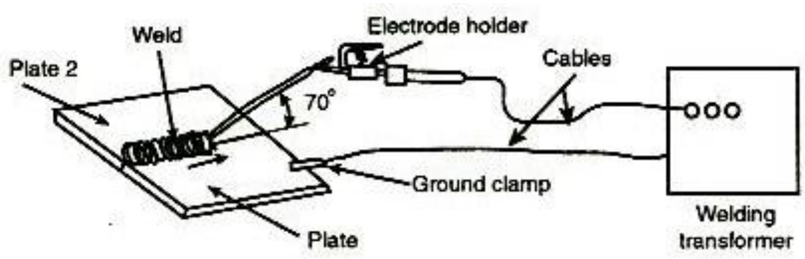
Types of Welding:

The two types of welding most prevalently in use are

1. Arc welding
2. Gas Arc welding

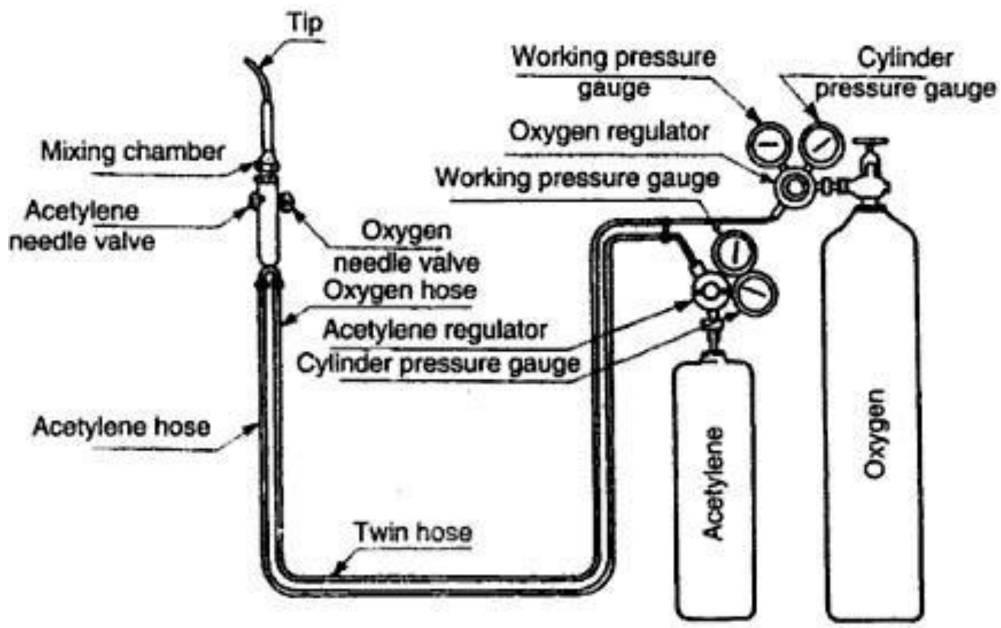
1. Arc welding:

Electric arc welding is widely used to join metal plates using a filler rod. The filler rod (welding rod) melts on the electric arc produced and welds the metal plates.



2. Gas welding

Gas welding is a process in which the required heat to melt the surfaces is supplied by a high temperature flame obtained by a mixture of two gases. Usually the mixture of oxygen and acetylene is used for welding purpose. The filler rod and parent metal plates are melted by the heat of the flame produced using oxygen and acetylene gas mixture. Gas welding is also widely used to join metal plates.



oxy-acetylene gas welding.

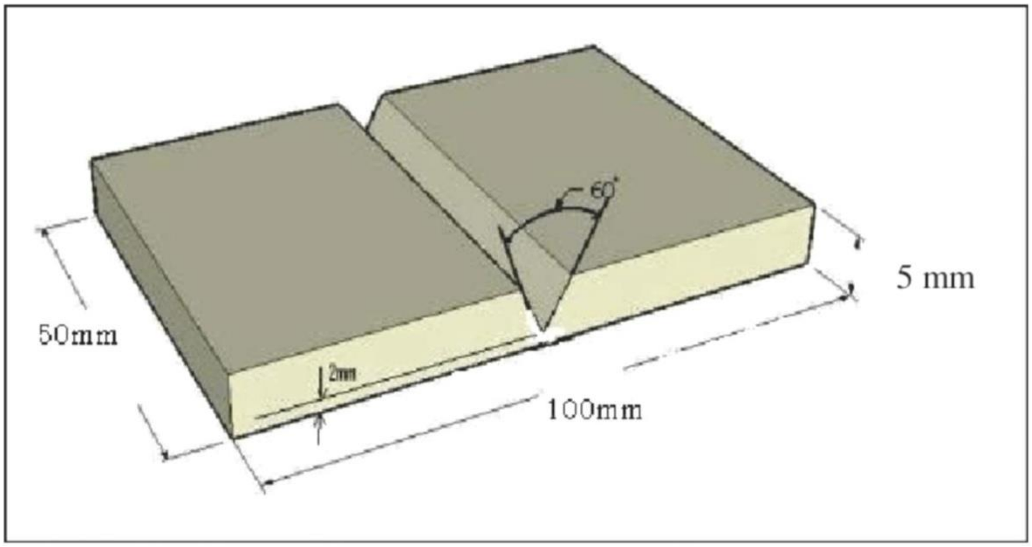
Result:

Thus the welding equipment's are studied.

Ex.No: 02

Single V Butt Joint

Diagram:



All dimensions are in 'mm'

Expt. No. 02 **SINGLE V BUTT JOINT**

Aim:

To join two given metal plates by a single 'V' butt joint in arc welding

Materials required:

MS flat: Length = 100 mm
Breadth = 50 mm
Thickness = 5 mm

Tools Required:

1. Welding transformer
2. Welding rods
3. Safety gloves
4. Goggle
5. Chipping hammer
6. Flat file

Procedure:

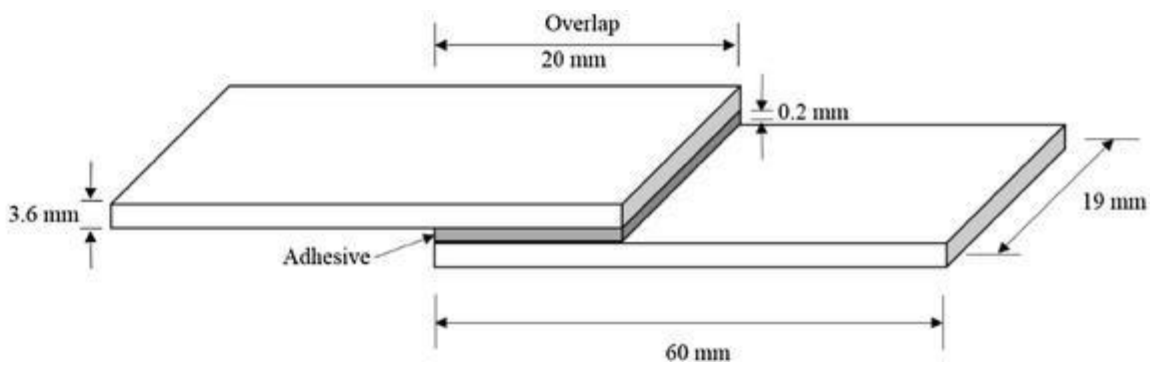
1. Check the surface to be welded and file the edge of the plates for perfect joint and more strength.
2. Hold the welding rod in the electrode holder and clamp the ground clamp to the plate to be welded.
3. Position the plates to be welded touching each other (butting) and tag weld on the ends to avoid the movement of the plates during welding.
4. Now start welding one end of the plates.
5. The electric arc produced melts the welding rod and joints the two metal plates. Maintain a gap of 3 mm between the plate and the welding rod.
6. Complete the welding process by removing slag using chipping hammer.

Result:

Thus the two metal plates are welded in single 'V' butt joint.

Ex.No: 03

Lap Joint



All the dimensions are in 'mm'

Expt. No. 03 **LAP JOINT**

Aim:

To join two given metal plates by a lap joint in arc welding

Materials required:

MS flat: Length =60 mm
Breadth = 19 mm
Thickness = 3.6 mm

Tools Required:

1. Welding transformer
2. Welding rods
3. Safety gloves
4. Goggle
5. Chipping hammer
6. Flat file

Procedure:

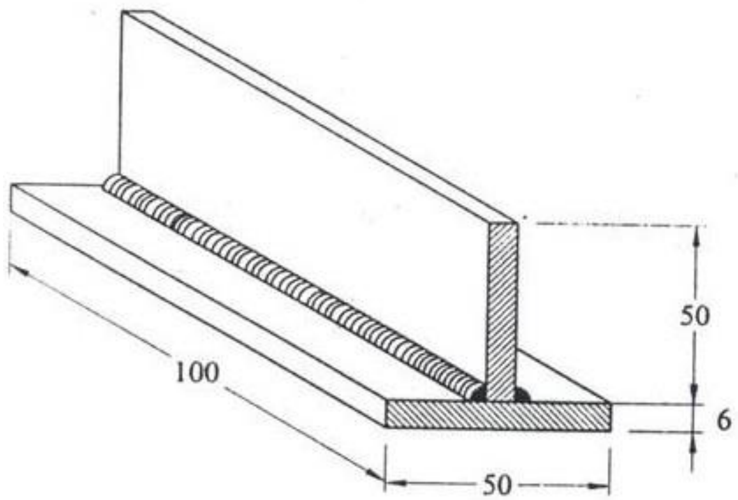
1. Clean the surface to be welded and file the edge of the plates for perfect joint and more strength.
2. Hold the welding rod in the electrode holder and clamp the ground clamp to the plate to be welded.
3. Position the plates to be welded overlapping and tag weld on the ends to avoid the movement of the plates during welding.
4. Now start welding one end of the plates.
5. The electric arc produced melts the welding rod and joints the two metal plates. Maintain a gap of 3 mm between the plate and the welding rod.
6. Complete the welding process by removing slag using chipping hammer.

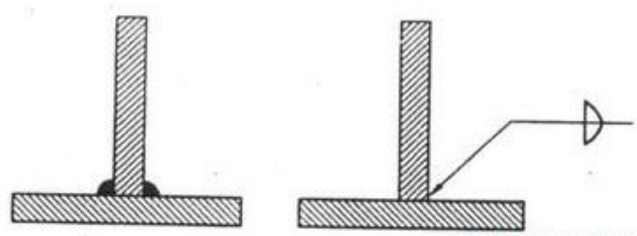
Result:

Thus the two metal plates are welded in lap joint.

Ex.No:04

TEE Fillet Joint





Welded Joint Representation

DO NOT SCALE
ALL DIMENTION ARE IN mm

Expt. No. 04 **TEE FILLET JOINT**

Aim:

To join two given metal plates by a tee fillet joint in arc welding

Materials required:

MS flat: Length = 100 mm
Breadth = 50 mm
Thickness = 6 mm

Tools Required:

1. Welding transformer
2. Welding rods
3. Safety gloves
4. Goggle
5. Chipping hammer
6. Flat file

Procedure:

1. Clean the surface to be welded and file the edge of the plates for perfect joint and more strength.
2. Hold the welding rod in the electrode holder and clamp the ground clamp to the plate to be welded.
3. Position one of the plates to be welded perpendicularly on the surface of the other plate. Tag weld on the ends to avoid the movement of the plates during welding.
4. Now start welding one end of the plates.
5. The electric arc produced melts the welding rod and joints the two metal plates. Maintain a gap of 3 mm between the plate and the welding rod.
6. Complete the welding process by removing slag using chipping hammer.

Result:

Thus the two metal plates are welded in tee fillet joint.

Expt. No. 05 **STUDY OF FOUNDRY**

Aim:

To understand the basic concepts of foundry by carrying out simple exercises relevant to its principles

Introduction:

Foundry is a process of forming different shapes and sizes of metals in their molten state. It is also called as metal casting. The shape of the metal cast obtained depends on the shape and size of the cavity produced in sand mould by using a wooden model. This wooden model is called a pattern.

The foundry process involves three steps:

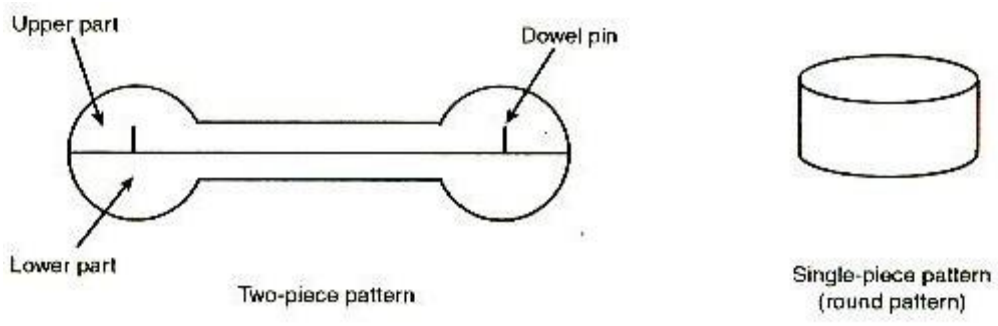
a. Making the required pattern

b. Moulding process to produce the cavity in sand using the pattern

c. Pouring the molten metal into the cavity to get the casing

Pattern:

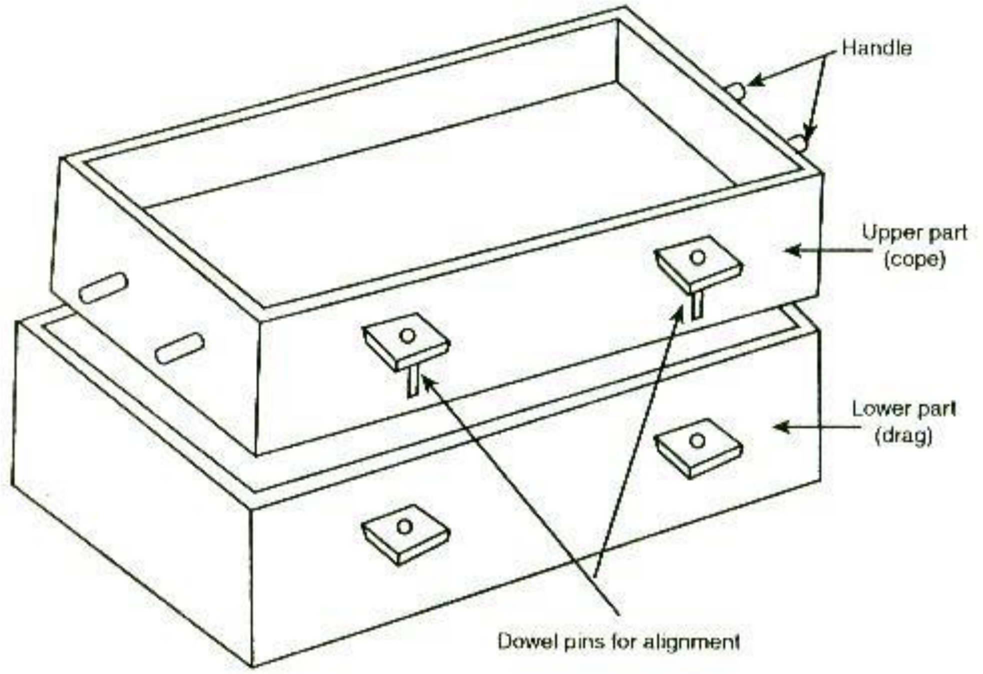
A pattern is normally a wooden model which is the facsimile of the cast/product to be made. There are many types of patterns and are either one piece or two - pieces.



Pattern

Moulding Box:

A moulding box is normally a rectangular wooden/metal box with bottom and top surfaces open. The upper part (cope) and the lower part (drag) are aligned properly.

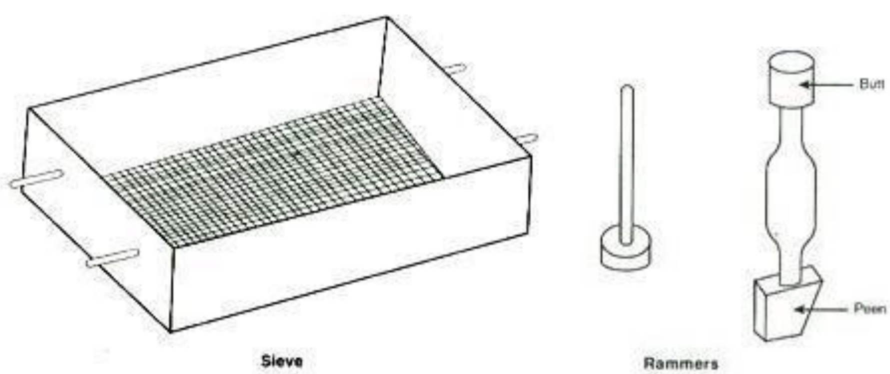


Sieve:

A sieve is used to remove foreign materials from the moulding sand. A sieve is a rectangular or circular frame with a wire mesh.

Rammer:

A rammer is used to press or ram the moulding sand uniformly into the moulding box.



Strike-off Bar:

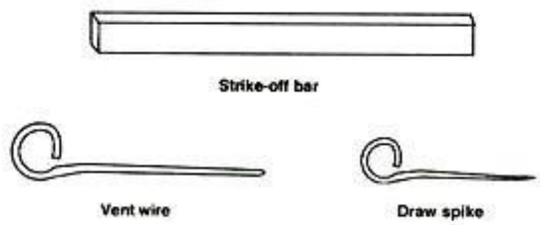
A strike off bar is a flat-edged rectangular bar made of wood. It is used to remove excess sand on top of the mould box after ramming.

Vent wire:

A vent wire is a steel wire used to produce holes in sand fill after ramming. This enables the gases to escape out to the atmosphere when the molten metal is poured into the cavity of the mould.

Draw spike:

A draw spike is a steel spike with sharp pointed end. This is used to pick the pattern from the mould after ramming.

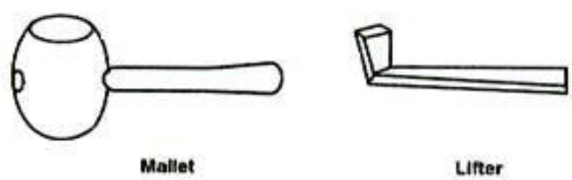


Mallet:

A mallet is used to give light blow to the draw spike to drive it into the pattern in order to lift the pattern with the help of draw spike. It is round or rectangular and is made of hard wood.

Lifter:

A lifter is used to remove the loose sand in the cavity produced in moulding. It is also used to finish the walls of the cavity after removing the pattern.

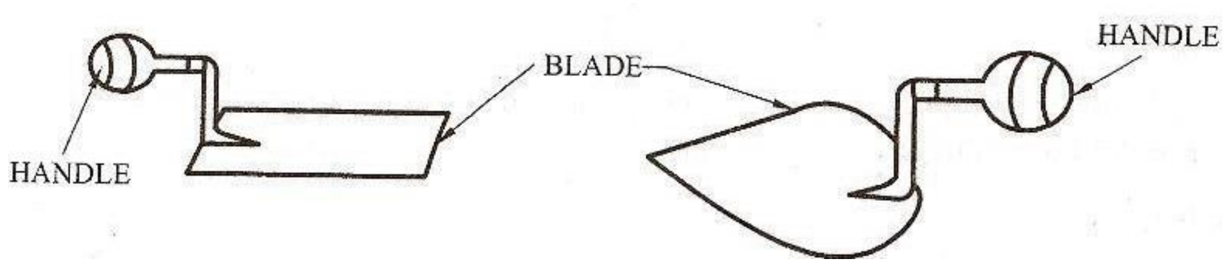


Trowel:

A trowel is used to finish the cavity obtained in the mould. Trowels of various shapes and sizes are used in moulding process.

Sprue Pin:

A sprue pin is a cylindrical and tapered wooden piece used to make a hole through which the molten metal is poured into the mould cavity.



Core:

The core is used to make a hole or hollow casting. The core is normally made of core sand. The core sand can be removed easily after the casting.

The core sand is having 90% silica sand and the remaining is binding materials (saw dust, asbestos, linseed oil, molasses etc.)

Shovel:

It is used to mix and move the mould sand from one place to another in the foundry shop. It consists of a broad iron pan fitted with a long wooden handle.

Bellow:

It is used to blow out sand particles and dust on the surface of the mould.

Swab:

It is used to apply water on the edges of the pattern before removing it from the mould. It is easy to remove the moisturized pattern, otherwise mould sand sticks along with the pattern.

Slick:

It is used to repair and smoothen the mould surface after removing the pattern. It consists of spoon shaped double ended trowel.

Gate cutter:

It is used to cut gates in the mould. The gate is connecting the runner hole and the mould cavity.

Melting furnaces:

The melting furnaces are used to melt the metal to be cast. Furnaces used to melt ferrous or non-ferrous metals are

1. Coke fired crucible furnace
2. Oil fired crucible furnace
3. Gas fired crucible furnace
4. Cupola furnace
5. Electric furnace

Shank Ladle:

The ladle is used to collect the molten metal from the crucible and pour it to the mould cavity.

Result:

Thus the foundry components were studied.

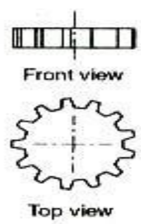
Expt. No. 06 **GEAR PATTERN**

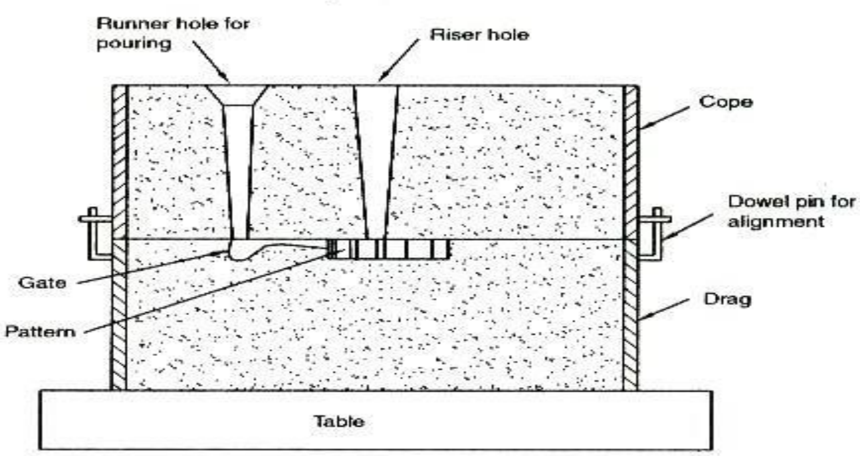
Aim:

To prepare a sand mould using a gear pattern

Tools required:

1. Shovel
2. Sieve
3. Mould box
4. Rammer
5. Trowel
6. Strike off bar
7. Lifter
8. Gate cutter
9. Runner
10. Riser
11. Vent rod
12. Draw spike
13. Swap etc.





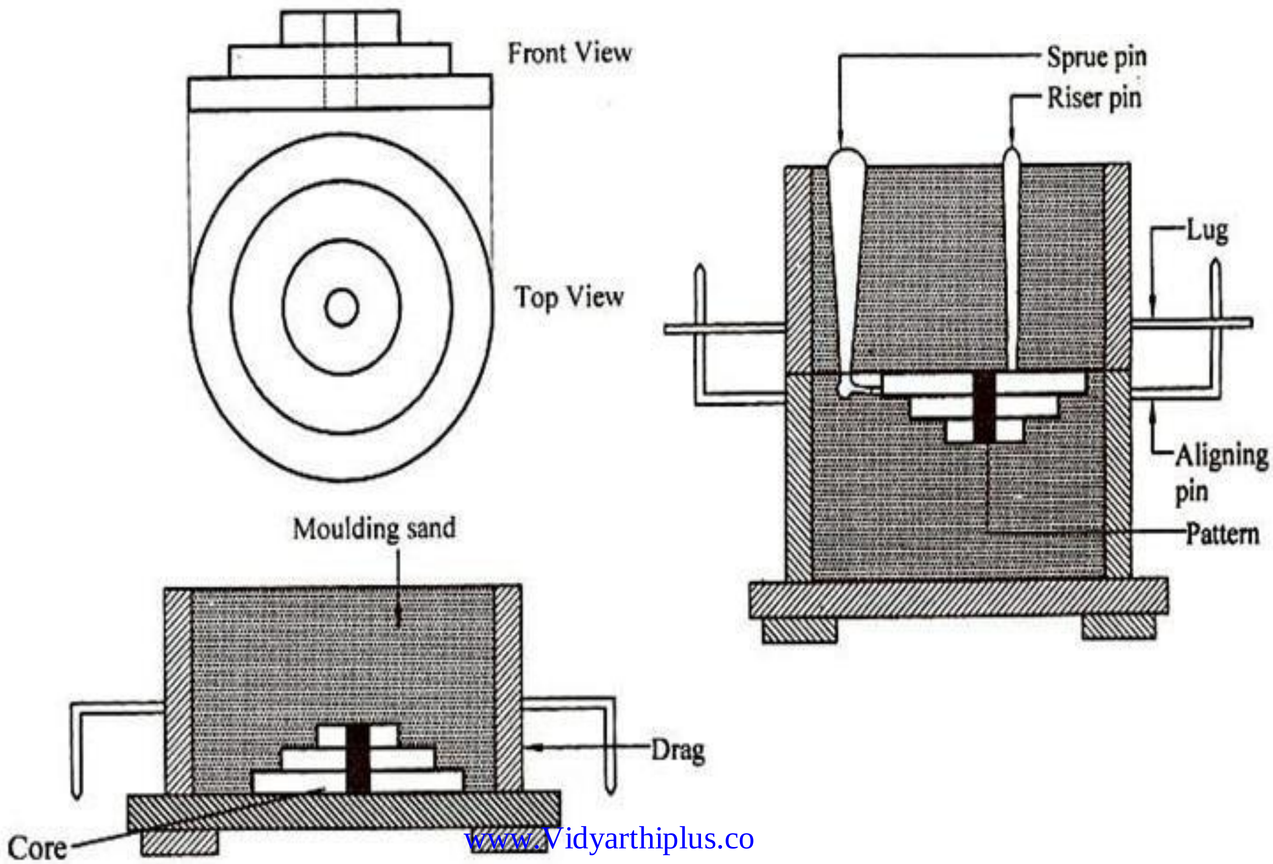
Procedure:

1. Clean the mould box, pattern, tools and table/floor.
2. Fill the drag with green sand after positioning the gear pattern on the table.
3. Ram the green sand carefully and the excess sand is struck off.
4. Tilt the drag upside down and sprinkle river sand on top of it.
5. Position the cope on top of the drag.
6. Position the sprue pin and riser pin, then fill the cope with sand and ramming is done and the excess sand is struck off.
7. Remove the sprue pin and the riser pin carefully.
8. Apply water on the edges of the pattern and remove it carefully using the draw spike, and then finish the cavity.
9. Vent holes are made using vent wire.
10. A funnel-shaped opening and gate is made to pour the molten metal.

Result:

Thus the mould of the given gear pattern is obtained

Expt. No. 07 **STEPPED CONE PULLEY**



Expt. No. 07 **STEPPED CONE PULLEY**

Aim:

To make the mould for the given stepped cone pulley

Tools required:

1. Trowel
2. Rammer
3. Strike off bar
4. Lifter
5. Runner
6. Riser
7. Gate cutter
8. Vent wire
9. Draw spike
10. Swap
11. Riddle
12. Sprue pin
13. Bellow
14. Moulding

Materials required:

1. Moulding sand
2. Parting sand
3. Facing sand

Procedure:

1. Clean the mould box, pattern, tools and the table / floor.
2. Prepare a suitable core with the help of core box.
3. Place the drag box above the moulding board. Now keep the pattern at center of the drag.
4. Sprinkle now parting sand before keeping the pattern.

5. Sprinkle facing sand over the pattern to a depth of 5 mm. Then fill the green sand over it.

6. Ram the green sand to get an air tight packing. Remove excess sand is removed by strike off bar.

7. Invert the drag box upside down. Place the cope box over the drag box and locked.

8. Place the raiser pin and sprue pin at right position and fill the green sand over the pattern.

9. The green sand to get air tight packing with strike off bar leveling is done.

10. Now remove riser pin and sprue pin from the green sand mould.

11. Remove the pattern by drag spike tool.

12. Prepare gate using gate cutter and place the core is placed vertically inside the cavity.

13. Mark the vent holes are made with vent wire on the cope.

Result:

Thus the mould of the stepped cone pulley is obtained.

Expt. No.08 **STUDY OF LATHE**

Aim:

To understand the working principle and operations done in lathe machine to identify the various components of lathe machine and its function

Machining processes:

Machining is one of the processes of manufacturing in which the specified shape to the work piece. Is imparted by removing surplus material. Conventionally this surplus material from the work piece is removed in the form of chips by interacting the work piece with an appropriate tool.

This mechanical generation of chips can be carried out by single point or multi point tools or by abrasive operations.

The machining operations are summarized below.

Machining Processes

Single point tool operations	**Multi-point tool operations**	**Abrasive operations**
1. Boring	1. Drilling	1. Lapping
2. Shaping	2. Tapping	2. Honing
3. Planning	3. Reaming	3. Super-finishing
4. Turning	4. Hobbing	4.Grinding
	5. Broaching	
	6. Sawing	
	7. Milling	

Multi-point tool operations:

The process of chip formation in metal cutting is affected by relative motion between the tool and the work piece achieved with the aid of a device called machine tool.

This relative motion can be obtained by a combination of rotary and translator movements of either the tool or the work piece or both.

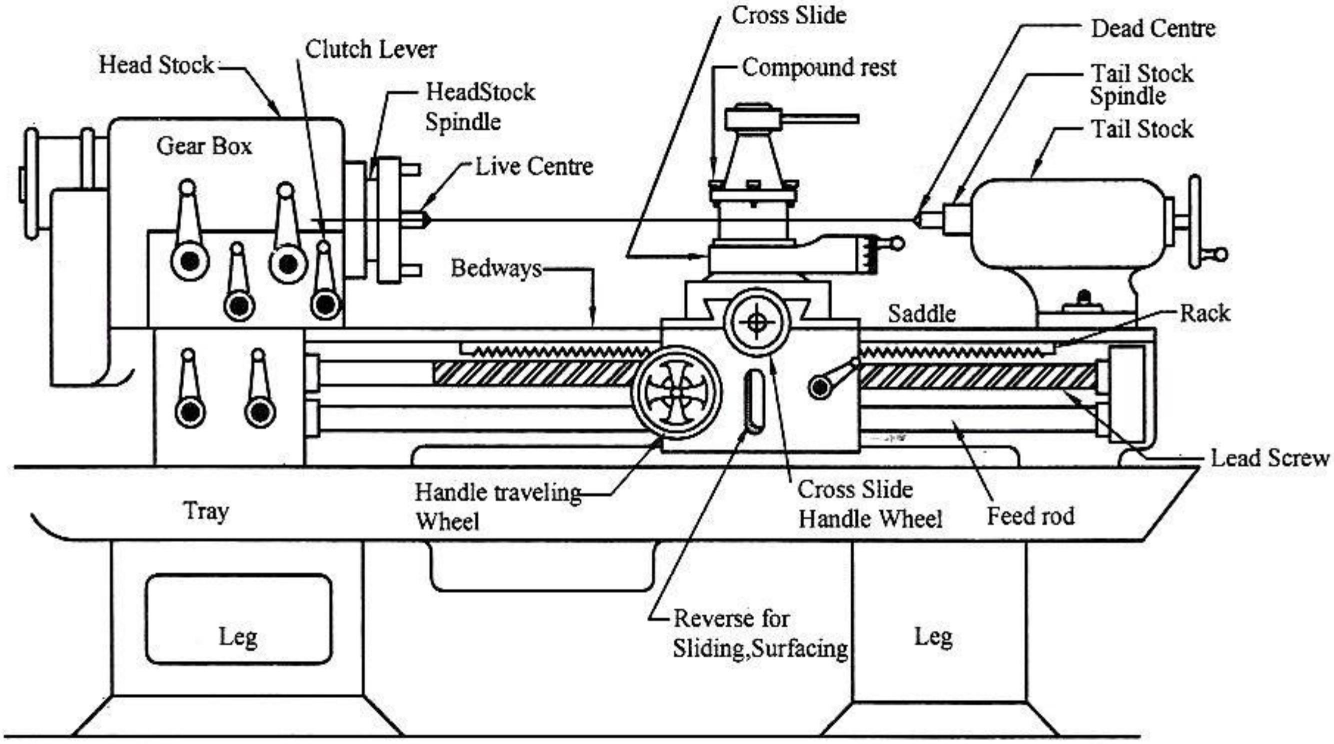
The kind of surface that is produced by the operation depends on the shape of the tool and the path it traverses through the materials.

The machine tools, in general, provide two kinds of relative motions. The primary motion is responsible for the cutting action and absorbs most of the power required to perform the machining action.

The secondary motion of the feed motion may proceed in steps or continuously and absorbs o1nly a fraction of the total power required for machining. When the secondary motion is added to the primary motion, machine surfaces of desired geometric characteristics are produced.

Lathe:

Lathe is the machine tool which is used to perform several operations on the work piece. Lathe is useful in making several parts which is further assembled to make new machine. Hence lathe is known as “mother of machines”



Centre Lathe

Basic working principle of lathe:

In lathe, the work piece is held in the chuck, a work holding device. The cutting tool is mounted in the tool post. The chuck is rotated by means of power. When the chuck rotates, the work piece also rotates.

The tool is moved against the rotating work piece by giving small amount of depth of cut. The material is removed in the form of chips. Continuous feed and depth of cut is given until the required dimensions are obtained in the work piece.

Types of lathe machines:

There are different types of lathe machines, they are

1. Centre lathe
2. Tool room lathe
3. Bench lathe
4. Capstan lathe
5. Turret lathe
6. Automatic lathe

Description of lathe:
Lathe is a machine which has several parts in it. They are,

Bed:

It is the base of the machine. On its left side, the head stock is mounted and on its right it has movable casting known as tailstock. Its legs have holes to bolt down on the ground.

Head stock:

It consists of spindles, gears and speed changing levers. It is used to transmit the motion to the job. It has two types; one is the headstock driven by belt and the other one is the gear driven.

Carriage:

Carriage is used to carry a tool to bring in contact with the rotating work piece or to with draw from such a contact. It operates on bed ways between the headstock and tail stock.

Saddle:

It is an 'H' shaped part fitted on the lathe bed. There is a hand wheel to move it on the bed way. Cross slide, compound rest, tool post is fitted on this saddle.

Cross slide:

It is on the upper slide of saddle in the form of dove tail. A hand wheel is provided to drive the cross slide. It permits the cross wise movement of the tool (i.e.) movement of tool towards or away from the operator.

Compound rest:

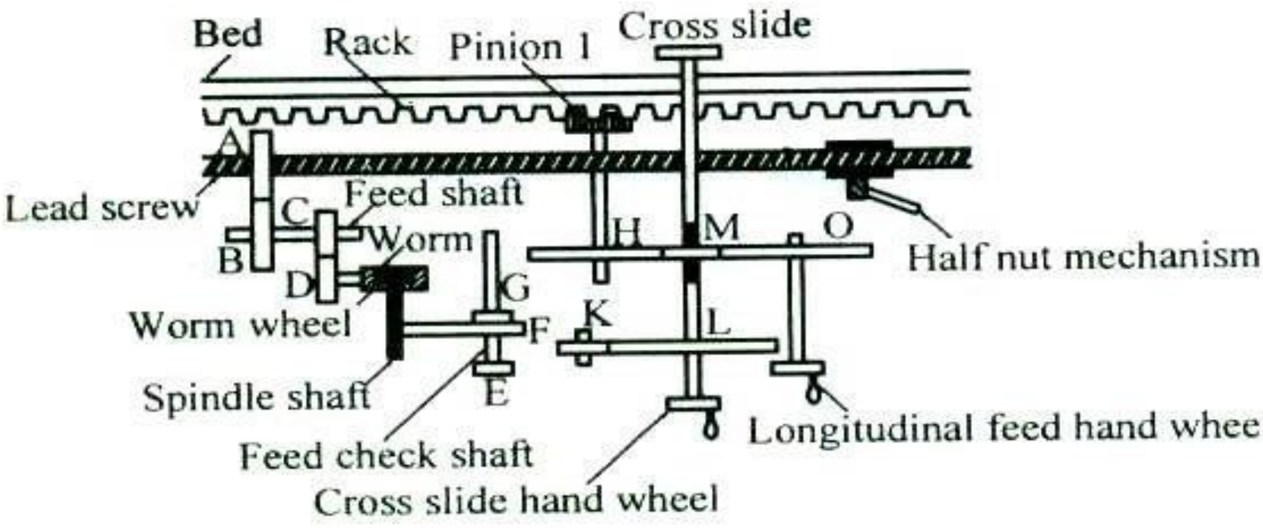
It is fitted over the cross slide on a turn table. It permits both parallel and angular movements to cutting tool.

Tool post:

It is fitted on the top most part of the compound rest. Tool is mounted on this tool post. Cutting tool is fixed in it with the help of screws.

Apron:

It is the hanging part in front of the carriage. It accommodates the mechanism of hand and power feed to the cutting tool for carrying out different operations.



Lead screw:

It is a long screw with ACME threads. It is used for transmitting power for automatic feed or feed for thread cutting operation.

Tail stock:

It is located at the right end of the lathe bed and it can be positioned anywhere in the bed. It is used for supporting lengthy jobs and also carries tool to carry out operations such as tapping, drilling and reaming.

Work holding devices:

Lathe centers:

They are used to support work. It has two categories of centers. Live center is one which is fitted in the head stock spindle. Dead is another one which is fitted in the tail stock.

Chuck:

It is a device used to hold a job. It is easily fitted on the thread cut on the end of head stock spindle. Various types of chuck are two jaw chuck, three jaw chuck, four jaw chuck collect chuck and magnetic chuck.

Cutting tools used:

For making a finished job on lathe machine, various types of cutting tools are used. One of them is single point cutting tool which is used to perform several operations on the work piece. Various types of cutting tools are furnished below.

Facing Tool:

It is used for facing the longitudinal ends of the job. Its shape is like a knife.

Rough Turning Tool:

It is used to remove excess material from the work piece in quick time. It can be used to give large depth of cut and work at coarse feed.

Finishing Tool:

It is used for getting smooth finish on the work piece. Its point is a little more round.

Radius Tool:

Jobs which need round cutting are done with this tool. Its types are Convex radius tool and concave radius tool.

Parting Tools:

It is used to cut the jobs into two parts. It is also used for grooving.

Form Turning Tool:

It is used for jobs which require both convex and concave turning.

Thread Cutting Tool:

It is used for making internal or external threads on the work piece. The tool nose is designed with a definite profile for taking threads.

Drill Tool:
It is used for making holes of various diameters on the job. Drill bit of various sizes of diameter are available.

Boring Tool:
It used for enlarging the drill hole.

Lathe operations:

Facing:
It is done for getting fine finish (good surface finish) on the face of the job. Facing tool is set at an angle to the work piece. The tool is fed from the centre of work piece towards the outer surface against the rotating work piece. Depth of cut is low for the facing operation.

Plain Turning:
It is done for reducing the diameter of the work piece. A cutting tool with 70 o setting angle is used for roughing operation. More feed is given for rough turning while less feed is given for finishing. Work piece is held in chuck and tool is set to center height of the work piece.

Step Turning:
It is similar to the process of turning but in this case different diameter in step of various sizes is taken on the work piece.

Taper Turning:
It is different from the turning operation. Taper is defined as uniform change in the diameter of a work piece measured along its length.
Where

D – Large diameter
d – Small diameter
l – Length of taper

Knurling:
It is process of making serrations on the work piece. Knurling tools of different shape and size are used to make grip on the work piece. It has two hardened steel rollers. The tool is held in tool post and pressed against the rotating work piece. Work piece is rotated at lower speed and small amount of feed is given.

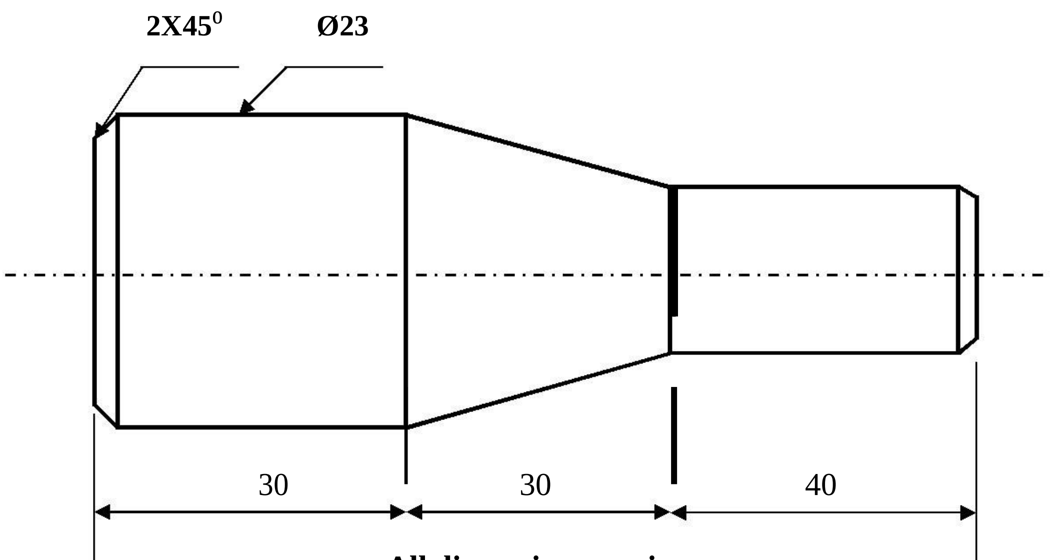
Drilling:
It is a process of making a hole on the work piece Job is held in chuck while the drill is held in the tail stock sleeve. Feed is given by rotating the hand wheel in the tail stock which pushes the tailstock sleeve.

Result
Thus the components of lathes are studied.

Ex. No.:09

TAPER TURNING

JOB DRAWING



All dimensions are in mm

Materials Supplied: Mild Steel Rod Ø25x 102mm

Tool Material: High Speed Steel (H.S.S)

Model Calculation:

Compound Rest Method:

$$\tan \Theta = \frac{D-d}{2L}$$

$$\Theta = \tan^{-1}\left(\frac{D-d}{2L}\right)$$

Where:

D = Major diameter of the work piece

d = Minor diameter of the work piece

L = Length of the work piece

Ex. No.: 09

TAPER TURNING

Aim:

To machine the given cylindrical rod as per the diagram using the lathe machine.

Tools required:

- ✓ Chuck Key
- ✓ Tool post spanner
- ✓ Turning tool
- ✓ Chamfering tool
- ✓ Vernier caliper
- ✓ Steel rule

Procedure:

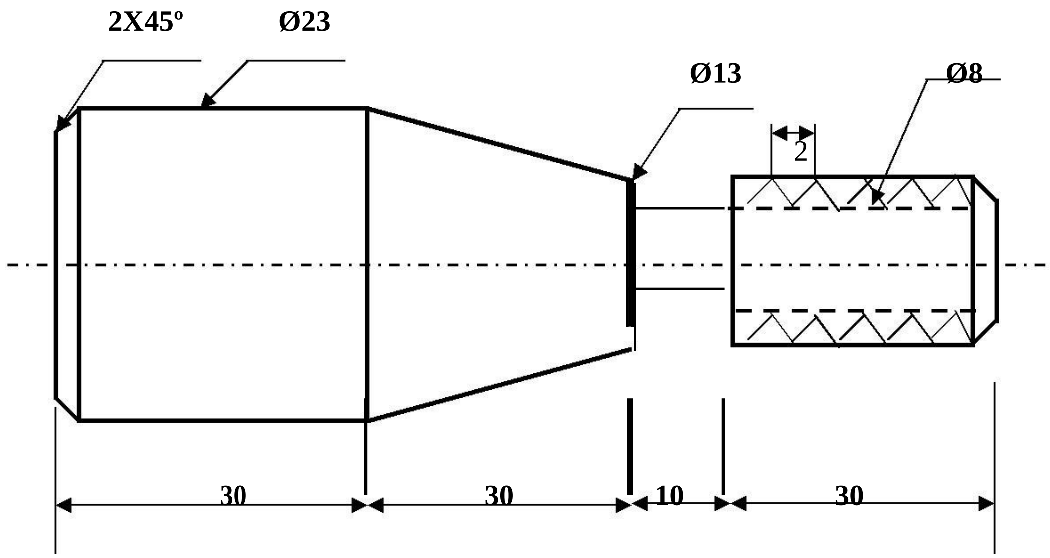
1. The work piece is held in the lathe chuck
2. The tool is set to coincide with lathe axis
3. The work piece is rotated about lathe axis
4. The facing and plain turning operations are carried out to the required dimensions
5. The step is machined at the end of the work piece
6. The carriage is clamped on the bed at required place.
7. The compound rest base is swiveled to the required taper angle and it is tightened
8. By moving the cross slide the angular feed is given the required dimensions.
9. The taper cylindrical surface is machined
10. Then both ends of the job are chamfered by chamfering tool.

Result:

The given work piece is machined as per the diagram using the lathe machine.

Ex. No.: 10 EXTERNAL THREAD CUTTING

JOB DRAWING



All dimensions are in mm

Materials Supplied: Mild Steel Rod Ø25x 102mm

Tool Material: High Speed Steel (H.S.S)

Ex. No.: 10

EXTERNAL THREAD CUTTING

Aim:

To machine the given cylindrical rod as per the diagram using the lathe machine.

Tools required:

- ✓ Chuck Key
- ✓ Tool post spanner
- ✓ Turning tool
- ✓ Chamfering tool
- ✓ Vernier caliper
- ✓ Centre gauge
- ✓ Steel rule

Procedure:

1. The work piece is held in the lathe spindle and it is rotated about lathe axis
2. By adopting usual procedure the facing and plain turning operations are carried out to the required dimensions.
3. Next the taper turning operation is carried out to the required dimensions by compound rest method
4. Then both ends of the job are chamfered by chamfering tool.
5. Remove the chamfering tool and insert the parting tool. Then calculate parting diameter and remove the material as per dimension.
6. The gear ratio is calculated and the suitable size gears are fitted in the change gear train
7. The “V” tool is clamped in the tool post and it is set perpendicular to lathe axis
8. The tool is moved away from job end. After giving suitable depth of cut the half nut is engaged.
9. The required depth of cut is given and the cycle is repeated to obtain the required depth.

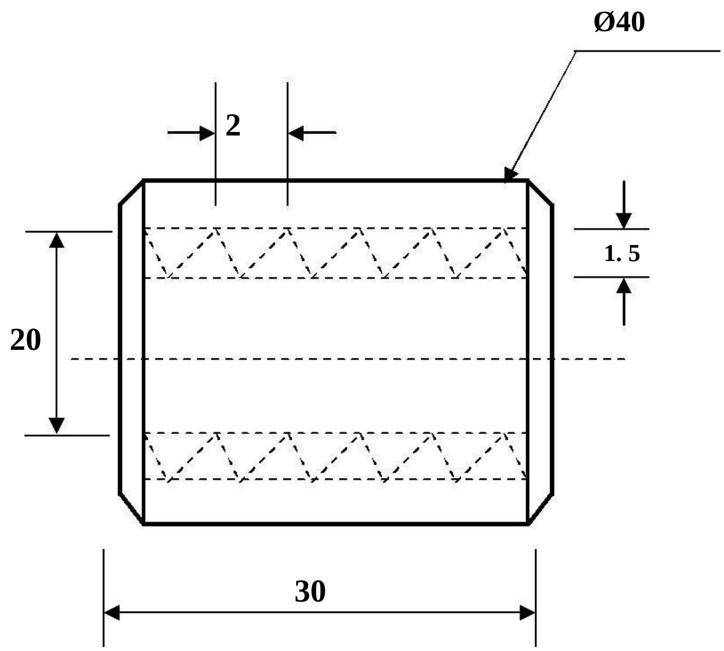
Result:

The given work piece is machined as per the diagram using the lathe machine.

INTERNAL THREAD CUTTING

Ex. No.: 11

JOB DRAWING



All dimensions are in mm

Materials Supplied: Mild Steel Rod Ø40x 50mm

Tool Material: High Speed Steel (H.S.S)

Ex. No.: 11 **INTERNAL THREAD CUTTING**

Aim:

To machine the given cylindrical rod as per the diagram using the lathe machine.

Tools required:

- ✓ Chuck Key
- ✓ Tool post spanner
- ✓ Turning tool
- ✓ Chamfering tool
- ✓ Boring tool
- ✓ Vernier caliper
- ✓ Drill bit
- ✓ Steel rule
- ✓ Thread Cutting Tool (Internal)

Procedure:

1. The work piece is held in the lathe spindle and it is rotated about lathe axis
2. The tool is held in the tool post and it is set to lathe axis
3. The facing and turning operations are carried out to the required dimensions
4. Insert drill bit in the tail stock
5. Then tail stock is moved and positional in a particular place.
6. Then the tool is moved towards the work piece to carriage out the drilling operations
7. Remove the turning tool and insert boring tool and carrying out boring operation
8. Remove the turning tool and insert the thread cutting tool
9. Calculate the change gear and set the change gear as per calculations
10. Make the thread cutting pitch using internal thread cutting procedure
11. Remove the work piece from the chuck and check the dimension

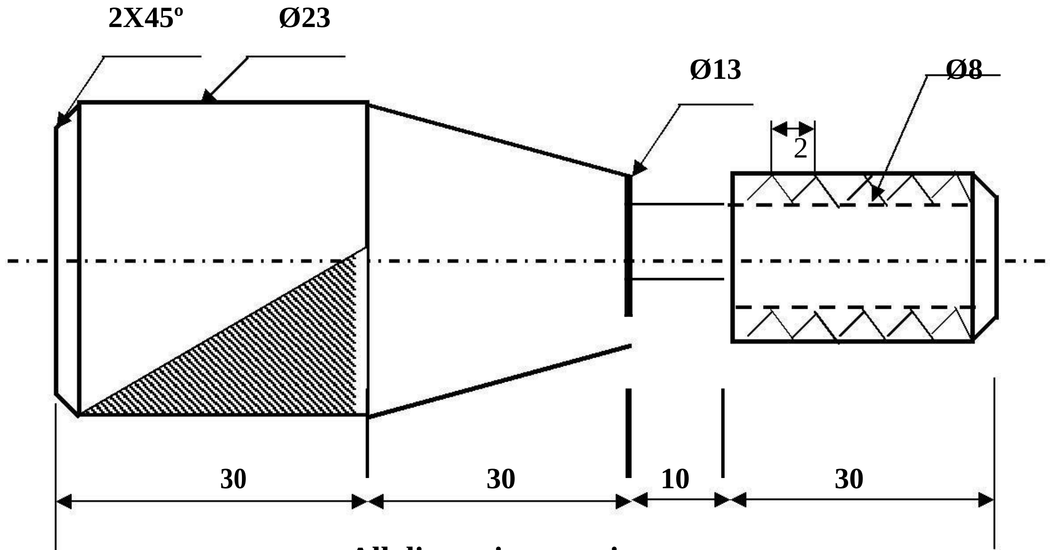
Result:

The given work piece is machined as per the diagram using the lathe machine.

KNURLING

Ex. No.: 12

JOB DRAWING



All dimensions are in mm

Materials Supplied: Mild Steel Rod Ø25x 102mm

Tool Material: High Speed Steel (H.S.S)

Ex. No.: 12 KNURLING

Aim:

To machine the given cylindrical rod as per the diagram using the lathe machine.

Tools required:

- ✓ Chuck Key
- ✓ Tool post spanner
- ✓ Turning tool
- ✓ Chamfering tool
- ✓ Vernier caliper
- ✓ Centre gauge
- ✓ Steel rule
- ✓ Knurling tool

Procedure:

1. The work piece is held in the lathe spindle and it is rotated about lathe axis
2. By adopting usual procedure the facing and plain turning operations are carried out to the required dimensions.
3. Next the taper turning operation is carried out to the required dimensions by compound rest method
4. The turning tool is replaced by knurling tool. The knurling tool is parallel against the rotating job
5. Then both ends of the job are chamfered by chamfering tool.

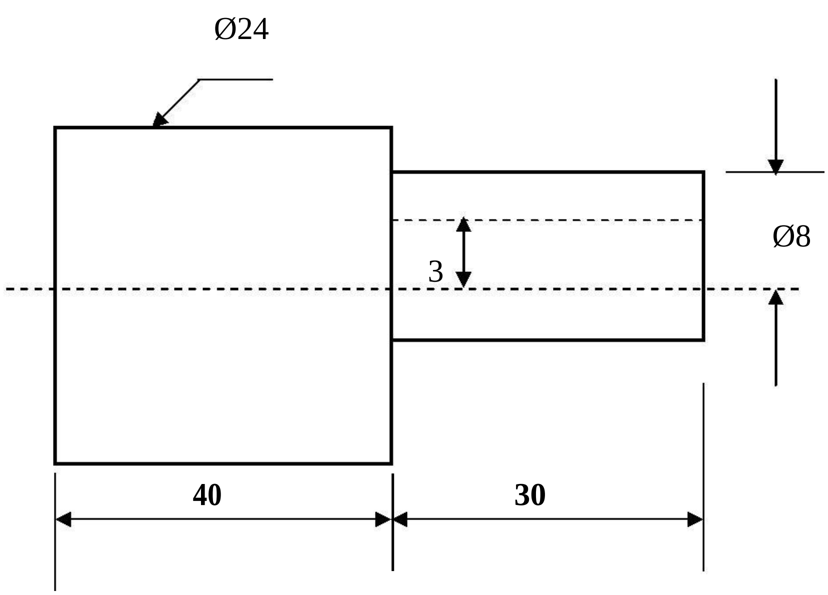
Result:

The given work piece is machined as per the diagram using the lathe machine.

ECCENTRIC TURNING

Ex. No.: 13

JOB DRAWNG



All dimensions are in mm

Materials Supplied: Mild Steel Rod Ø25x 102mm

Tool Material: High Speed Steel (H.S.S)

Ex. No.: 13

ECCENTRIC TURNING

Aim:

To machine the given cylindrical rod as per the diagram using the lathe machine.

Tools required:

- ✓ Chuck Key
- ✓ Tool post spanner
- ✓ Turning tool
- ✓ Chamfering tool
- ✓ Vernier caliper
- ✓ Drill bit ø 10mm
- ✓ Steel rule

Procedure:

1. The work piece is held in the lathe spindle and it is rotated about lathe axis
2. The tool is held in the tool post and it is set to lathe axis
3. The facing and turning operations are carried out to the required dimensions
4. Then the axis of the work piece is shifted to the required eccentricity
5. The longitudinal feed is given to the required length and job is eccentrically turned.
6. Two or more cuts with suitable depth of cut are given to obtain required diameter
7. Then both ends of the job are chamfered by chamfering tool.

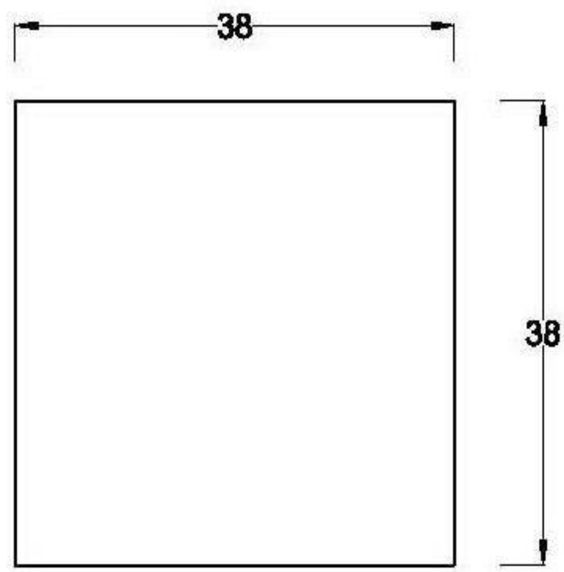
Result:

The given work piece is machined as per the diagram using the lathe machine.

SQUARE HEAD SHAPING

Ex. No.: 14

JOB DRAWNG



All dimensions are in mm

Materials Supplied: Mild steel: 40mmX 40mmX40mm

Tool Material: High Speed Steel (H.S.S)

Ex. No: 14

SQUARE HEAD SHAPING

Aim

To machine the given rectangular block in the shaping machine

Tools Required

Round nose tool	-	1 No
Vernier caliper	-	1 No
Steel Rule	-	1 No
Hammer, Punch, Scriber	-	1 No
Try square	-	1 No
Vernier height gauge	-	1 No

Procedure

1. The given raw material rectangular block is measured. The machining allowances are noted. Then the job is coated with white chalk for marking purpose.
2. The job is position in the marking table. The vernier height gauge is set to the correct dimensions as per the part drawing dimensions
3. After, the height -- mm is corrected in the vernier height gauge; the vernier scriber is marked in the face sides of the rectangular block.
4. To identify the dimensions of the job, the marking lines are punched
5. The work piece is placed in the shaping machine work holding device in correct position. Tool is held in the head in suitable position.
6. The stroke length and initial cutting position are corrected by adjusting the ram and table manually
7. The tool is held in the tool post in vertical position
8. Now, the machine is switched ON. The tool moves over the work, the materials is removed from the work by the tool cutting force.
9. By giving cross-feed movement to the table, the total length of work is machined, after completion of one cut, the depth of cut is adjusted in the tool head. Then the next cut is taken.
10. By repeating the above same procedure, the other faces are machined to the required dimensions
11. After completion of six faces, the work is removed from the vice, cleaned and inspection is carried out. The job No / Roll No are punched in the face side of the work.

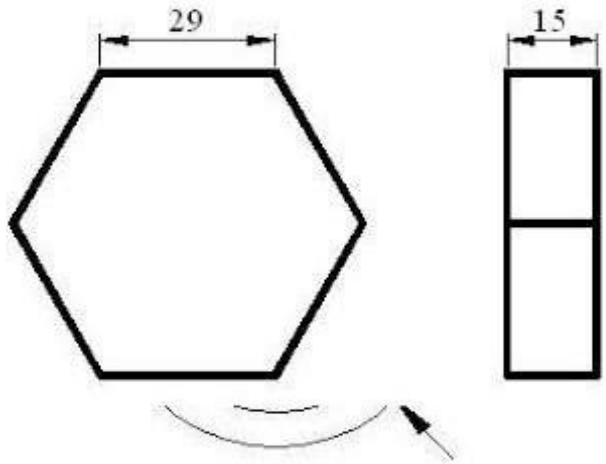
Result

The given work piece rectangular block is machined as per the dimension in the shaping machine.

HEXAGONAL HEAD SHAPING

Ex. No.: 15

JOB DRAWNG



All dimensions are in mm

Materials Supplied: Mild steel: 40mmX 40mmX40mm

Tool Material: High Speed Steel (H.S.S)

Ex. No: 15

HEXAGONAL HEAD SHAPING

Aim:

To machine a hexagon in the given work piece to the dimensions as shown in the figureusing Shaping Machine

Tools Required:

- ✓ Shaping Machine,
- ✓ Scriber, Divider,
- ✓ Steel Rule,
- ✓ Chalk piece,
- ✓ Bevel Protractor.

Procedure:

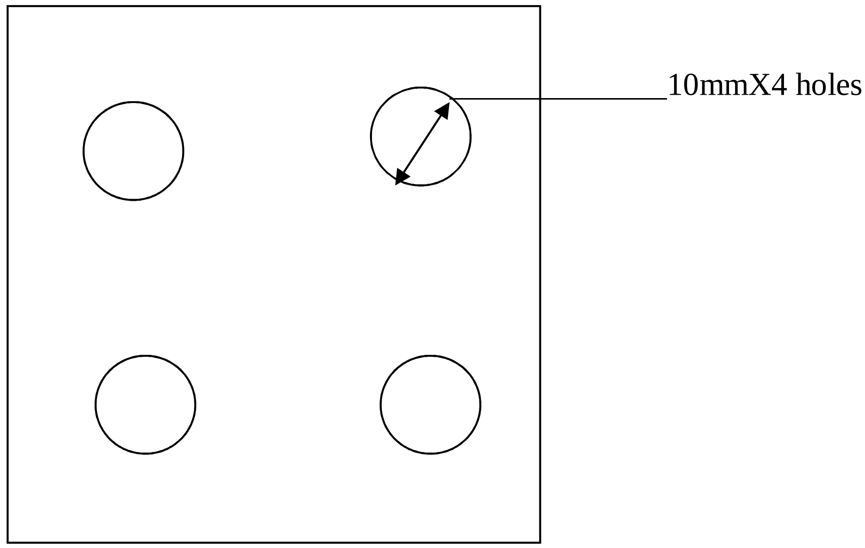
1. The given work piece is measured for its initial dimensions.
2. With the help of scriber, mark the hexagon dimensions in the work piece.
3. Fix the work piece in the vice of the shaping machine.
4. After fixing the work piece and the shaping tool, allow the ram to reciprocate.
5. Start the shaping process by giving the required depth by lowering the tool.
6. Slowly increase the depth of cut and repeat the procedure to make the hexagon shape.
7. The work piece is now checked for final dimensions.

Result:

Thus, a hexagon is machined in the given work piece to the dimensions as shown inthe figure using Shaping Machine.

Ex. No.: 16

JOB DRAWNG



All dimensions are in mm

Materials Supplied: Mild steel: 40mmX 40mm

Tool Material: High Speed Steel (H.S.S)

Ex. No: 16 **DRILLING AND REAMING USING VERTICAL DRILLING MACHINE**

Date:

Aim :

To machine a drilling and reaming in the given work piece to thedimensions as shown in the figure using vertical drilling machine

Tools Required :

- ✓ Radial drilling Machine,
- ✓ Scriber, Divider,
- ✓ Steel Rule,
- ✓ Chalk piece,
- ✓ Bevel
- ✓ Protractor.

Procedure:

1. The given work piece is measured for its initial dimensions.
2. With the help of scriber, mark the hexagon dimensions in the work piece.
3. Fix the work piece in the vice of the radial drilling machine.
4. Start the process by giving the required depth by lowering the drilling tool.
5. Slowly increase the depth of cut and repeat the procedure to make the drill hole.
6. Hold the work piece by vice and make fine holes by using reaming tool.
7. The work piece is now checked for final dimensions.

Result:

Thus, drilling and reaming was done on the given work piece to thedimensions as shown in the figure using radial drilling machine.

Ex. No: 17 **STUDY OF MILLING MACHINE**

Date:

Introduction

Milling is the name given to the machining process in which the removal of metal takes place due to cutting action of a revolving cutter when the work is fed past it. The revolving cutter is held on a spindle and the work, clamped on the machine table, fed past the same.

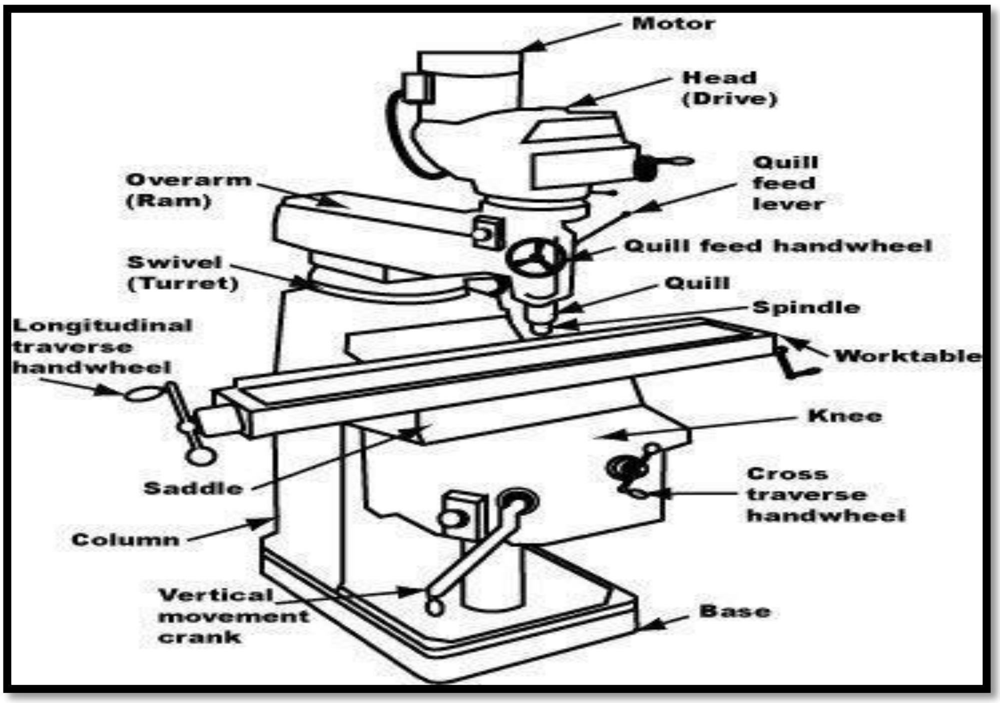
Milling is the cutting operation that removes metal by feeding the work against a rotating, cutter having single or multiple cutting edges. Flat or curved surfaces of many shapes can be machined by milling with good finish and accuracy. A milling machine may also be used for drilling, slotting, making a circular profile and gear cutting by having suitable attachments.

WORKING PRINCIPLE IN MILLING:

The working principle, employed in the metal removing operation on a milling machine, is revolving multi teeth cutter mounted either on a spindle. The cutter revolves at a fairly high speed and the work fed slowly past the cutter. 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. The work piece is holding on the worktable of the machine. The table movement controls the feed of work piece against the rotating cutter.

The cutter is mounted on a spindle and revolves at high speed. Except for rotation the cutter has no other motion. As the work piece advances, the cutter teeth remove the metal from the surface of work piece and the desired shape is produced.



MILLING MACHINE

TYPES OF MILLING MACHINES:

A large variety of different types of milling machines is available. The classification of these type machines can be done as follows:

1. Column and knee type milling machines
2. Fixed bed type or manufacturing type milling machines
3. Planer type milling machines
4. Production milling machines
5. Special purpose machines

COLUMN AND KNEE TYPE MILLING MACHINES:

These machines are all general purpose machines and have a single spindle only. They are further classified as follows:

(a) Hand milling machine
(b) Plain or horizontal milling machine
(c) Vertical milling machine and
(d) Universal milling machine

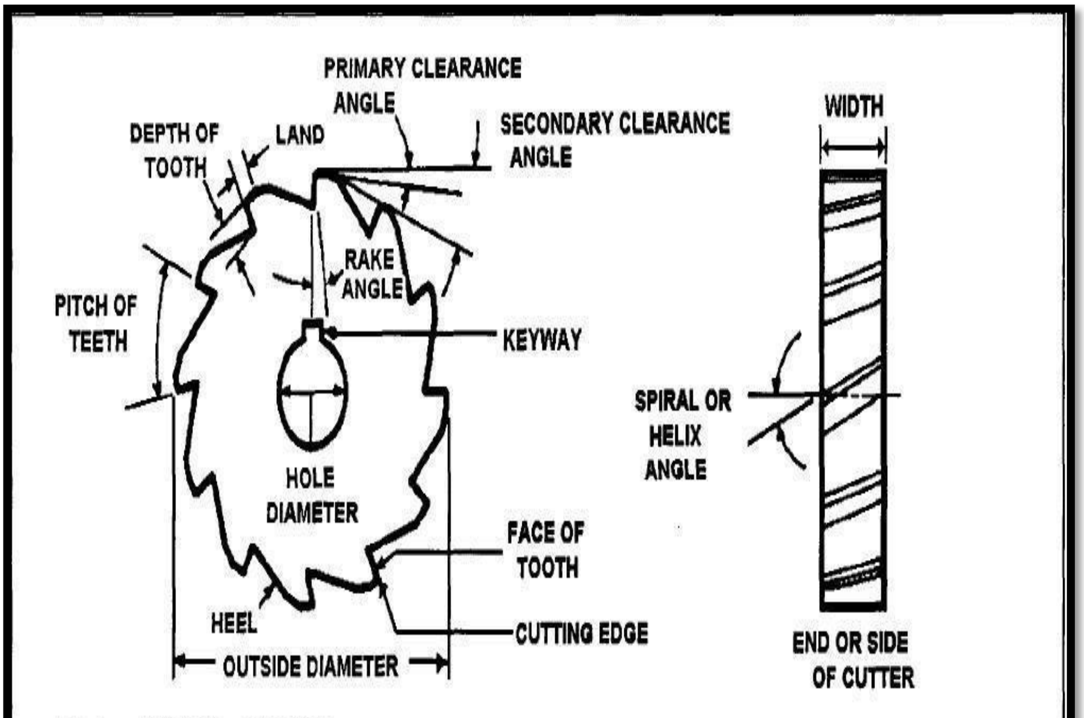


Figure Milling cutter nomenclature.

FIXED BED TYPE OR MANUFACTURING TYPR MILLING MACHINE:

These machines, in comparison to the column and knee type, are more sturdy and rigid, and heavier in weight and larger in size. Their further classification is as follows:

(a) Plain type (having single horizontal spindle).
(b) Duplex head (having double horizontal spindles).
(c) Triplex head (having two horizontal and one vertical spindle).
(d) Rise and fall type (for profile milling)

PLANER TYPE MILLING MACHINES:

They are used for heavy work. Up to a maximum of four tool heads can be mounted over it, which can be adjusted vertically and transverse directions. It has a robust and massive construction like a planar.

PRODUCTION MILLING MACHINES:

They are also manufacturing machines but differ from the above described machines in that they do not have a fixed bed. They include following machines:

(a) Rotary table or continuous type.
(b) Drum type and
(c) Tracer controlled

SPECIAL PURPOSE MILLING MACHINES:

These machines are designed to perform a specific type of operation only. They include following machines:

(a) Thread milling machine

(b) Profile milling machine

(c) Gear milling or gear hobbing machine

(d) Cam milling machine

(e) Planetary type milling machine

(f) Double end milling machine

(g) Skin milling machine and

(h) Spar milling machine.

PLAIN OR HORIZONTAL MILLING MACHINE

The vertical column serves as a housing for electrical, the main drive, spindle bearings, etc. The knee acts as support for the saddle, worktable 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, vertical. For giving vertical movement to the table the knee it, together with the whole unit above it, slides up and down along the ways provide in front of the column. A brace is employed to provide additional support and rigidity to the arbor when a long arbor is used. Both hand power and power feeds can be employed for the work.

VERTICAL MILLING MACHINE:

It derives its name from the vertical position of the spindle. This is available in both types; the fixed bed type as type as well as column and knee type. It carries a vertical column on a heavy base. The over arm in this machine is made integral with the column and carries a housing at its front. This housing called head can be of fixed type .In fixed type, the spindle always remains vertical and can be adjusted up and down.

The knee carries an enclosed screw jack, by means of which it is moved up and down along the parallel vertical guide ways provided on the front side of the column. The saddle is mounted on the knee and can be moved, along the horizontal guide ways provided on the knee, towards or away from the column. This enables the table to move in cross direction. The work gets up and down movement by the knee, cross movement by saddle and longitudinal movement by the table.

PARTS OF MILLING MACHINE:

Main parts of the milling machines are similar; all these machine essentials consist of the following main parts:

1. **BASE**:

   It is a heavy casting provided at the bottom of the machine. It is accurately machined on both the top and bottom surfaces. It actually acts as a load bearing member for all other parts of the machine. Also it carries the screw jack which supports and moves the knee. In addition to this it also serves as reservoir for the coolant.

2. **COLUMN**:

   It is a very prominent part of the milling machine and is produced with enough care. On the front face of the column are made the vertical parallel ways in which the knee slides up and down. It carries the enclosed motor drive. Top of the column carries dovetail horizontal ways for the over arm.

3. **KNEE**:

It is a rigid casting, which is capable of sliding up and down along the vertical ways on the front face of the column. This enables the adjustment of the table height. The adjustment is provided by operating the elevating jack, provided below the knee, by means of hand wheel or application of power feed. For efficient operation of the machine, rigidity of the knee and accuracy of its ways play an important role. On the front face of the knee two bolts are usually provided for securing the braces to it to ensure greater rigidity under heavy loads.

4. **SADDLE:**

It is the intermediate part between the knee and the table and acts as a support for the latter. It can be adjusted crosswise, along the ways provided on the top of the knee, to provide cross feed to the table. As its top, it carries horizontal ways, along which moves the table during longitudinal traverse.

5. **TABLE:**

It acts as a support for the work. It is made of cast iron, with its top surface accurately machined. Its top carries longitudinal cross T-slots to accommodate the clamping bolts for fixing the work or securing the fixtures. Also, the cutting fluid, after it is used, drains back to the reservoir through these slots and then the pipe fitted for this purpose. Longitudinal feed is provided to it by means of hand wheel fitted on one side of the feed screw. Cross feed is provided by moving the saddle and vertical feed by rising or lowering the knee.

6. **OVERARM:**

It is the heavy support provided on the top of both plain and universal milling machine. It can slide horizontally, along the ways provided on the top of the column, and adjusted to a desired position in order to provide support to the projecting arbor by accommodating its free end in the yoke.

Result

Thus the components of milling machines are studied.

Ex.N0: 18 CONTOURMILLING USING VERTICAL MILLING MACHINE

AIM:

To machine a groove in the given work piece using vertical milling machine.

TOOLS REQUIRED:

1. Milling machine
2. Vernier caliper
3. Steel rule
4. Machine vice
5. Centre punch

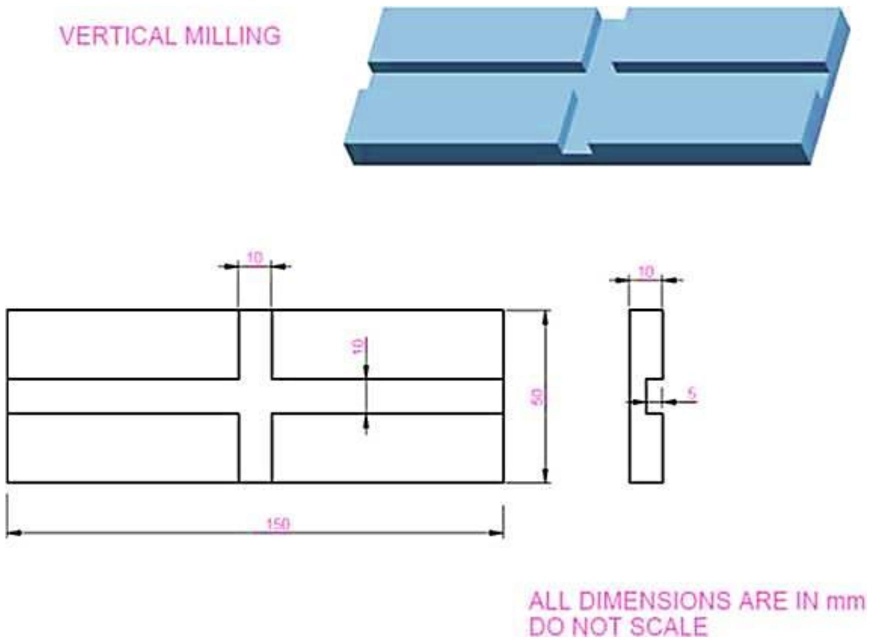
MATERIAL REQUIRED:

150 X 50 X 10 mm Cast Iron flat

PROCEDURE

1. Check whether the machine is in proper condition.
2. Check whether the work piece which gives in suitable size.
3. The job is marked to the desired shape and punched.
4. Hold the work piece in the vice and fix the tool in the arbor in correct position and machine is started.
5. The minimum depth of cut is given and feed is given by reciprocating table.
6. Remove the job and check the dimensions.
7. Continue the steps to obtain required dimensions.

DIAGRAM:



RESULT:

Thus the vertical milling operation was performed on the given work piece using vertical milling machine.

Ex.No: 19 SPUR GEAR CUTTING IN MILLING MACHINE

AIM:

To machine gear to the given module and number of teeth in the given work piece.

TOOLS AND EQUIPMENTS REQUIRED:

1. Milling machine
2. Vernier caliper
3. Mandrel.

PROCEDURE:

1. Calculate the gear tooth proportions.
   Where,
   Blank diameter = (Z + 2) m
   Tooth depth = 2.25 m
   Tooth width = 1.5708 m
   Z = Number of teeth required
   m = module

   Indexing calculation

   Index crank movement = 40 / Z

2. The dividing head and the tail stock are bolted on the machine table. Their axis must be set parallel to the machine table.
3. The gear blank is held between the dividing head and tailstock using a mandrel. The mandrel is connected with the spindle of dividing head by a carrier and catch plate.
4. The cutter is mounted on the arbor. The cutter is centered accurately with the gear blank.
5. Set the speed and feed for machining.
6. For giving depth of cut, the table is raised till the periphery of the gear blank just touches thecutter.
7. The micrometer dial of vertical feed screw is set to zero in thisposition.
8. Then the table is raised further to give the required depth ofcut.
9. The machine is started and feed is given to the table to cut the first groove of the blank.
10. After the cut, the table is brought back to the starting position.
11. Then the gear blank is indexed for the next tooth space.
12. This is continued till all the gear teeth are cut.

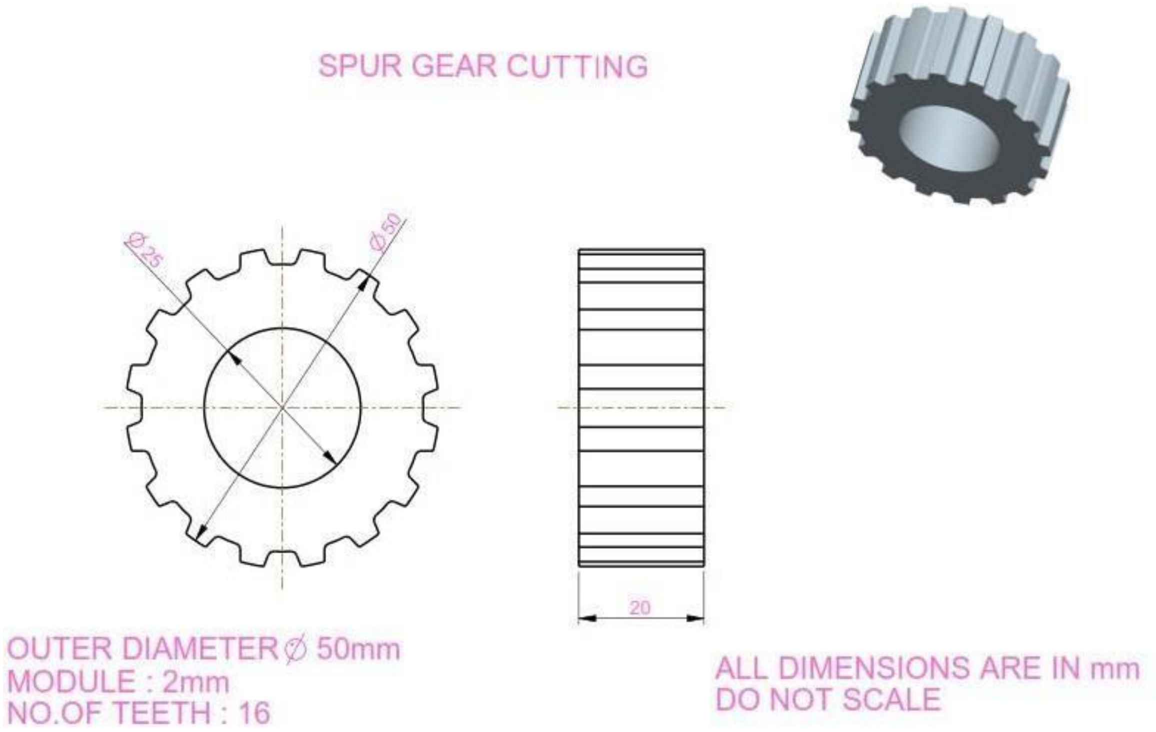
CALCULATION:

Z = No. of teeth = 23
m = module = 2 mm
Blank Diameter = (Z + 2) *m
= (23 + 2) *2
= 50 mm

Tooth Depth = 2.25m
= 2.25 *2
= 4.5 mm

Indexing Calculation
= 40 / Z
= 40 / 23
= 1.739

DIAGRAM:



RESULT:

Thus the required gear is machined using the milling machine to the required number of teeth

Ex.No: 20 **HELICAL GEAR CUTTING IN MILLING MACHINE**

AIM:

To make a helical gear from a CI blank using milling machine

MATERIAL REQUIRED:

Cast iron blank of Φ50mm

TOOLS REQUIRED:

1. Turning tool
2. Milling cutter (2mmmodule)
3. Vernier caliper(0-150mm)
4. Drilling tool Φ 10mm,Φ20mm
5. MandrelΦ20mm
6. Spanner
7. Gear tooth Vernier

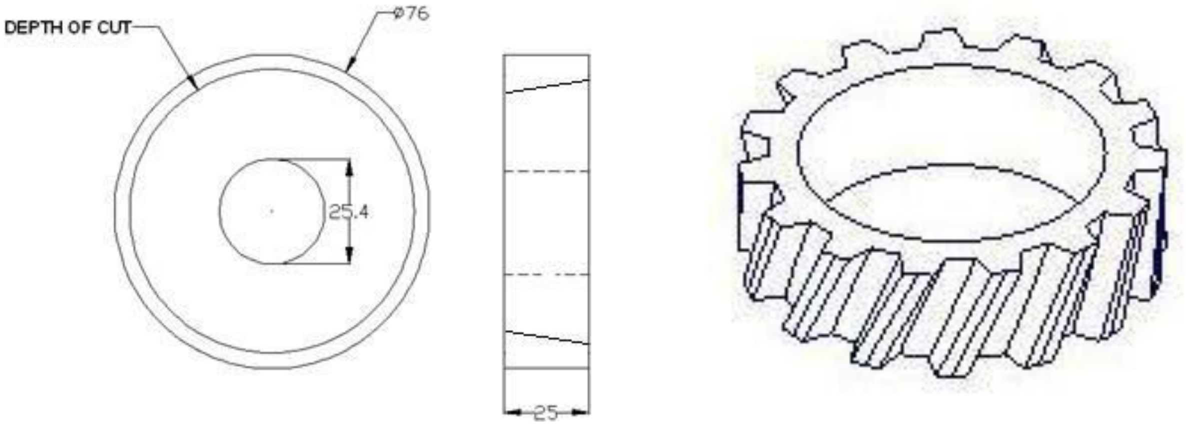
FORMULA:

Outer diameter = (N+2) M,
Module =OD/ (N+2),
No .of teeth = (OD/M) -2
N- Number of teeth M= module OD = outer diameter

PROCEDURE:

1. Turn the given CI bank to required diameter in centre lathe.
2. Drill a hole in the blank of diameter equal to mandrel size.
3. Fix the blank between two centers of the dividing head using mandrel.
4. Set the milling cutter on the machine spindle and select the suitable speed.
5. Raise the table (knee) vertically up until blank touches the cutter.
6. Calculate depth of cut and indexing calculation from module & number of teeth.
7. Give the depth of cut by raising the knee up.
8. According to index calculation set the dividing head.
9. Switch on the spindle and feed the blank against the rotating cutter by reciprocating the table
10. Move the index arm on the index plate according to the calculated number of holes.
11. Feed the blank against the rotating cutter to cut the next tooth.
12. Repeat the same for remaining teeth

DIAGRAM:



MODEL CALCULATION FOR HELICAL GEAR:

No of teeth (z) =30

Module (m) =2mm

External dia. Of blank =(z+2)*m

= (30+2)*2=64

Depth of cut =2.25*m

=2.25*2

=4.5mm

The indexing crank rotation = one complete rotation and move arm holes in 33 concentric circle.

RESULT:

Thus the spur gear has made by using milling machine to the required size.

Ex.No: 21 **STUDY OF GRINDING MACHINE**

INTRODUCTION:

Grinding is metal cutting operation performed by means of a rotating abrasive wheel that acts as a tool. This is used to finish work pieces which must show a high surface quality, accuracy of shape and dimension. The art of grinding goes back many centuries. Columns and statues were shaped and finished with a globular stone which abraded the surface.

Mostly grinding is a finishing operation because it removes comparatively little metal 0.25 to 0.50 mm in most operations and the accuracy is in the order of 0.000025 mm. many different types of grinding machines have now been developed for handling various kinds of work to which the grinding process is applicable. A grinding machine is a machine tool used for grinding, which is a type of machining using an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the work piece via shear deformation.

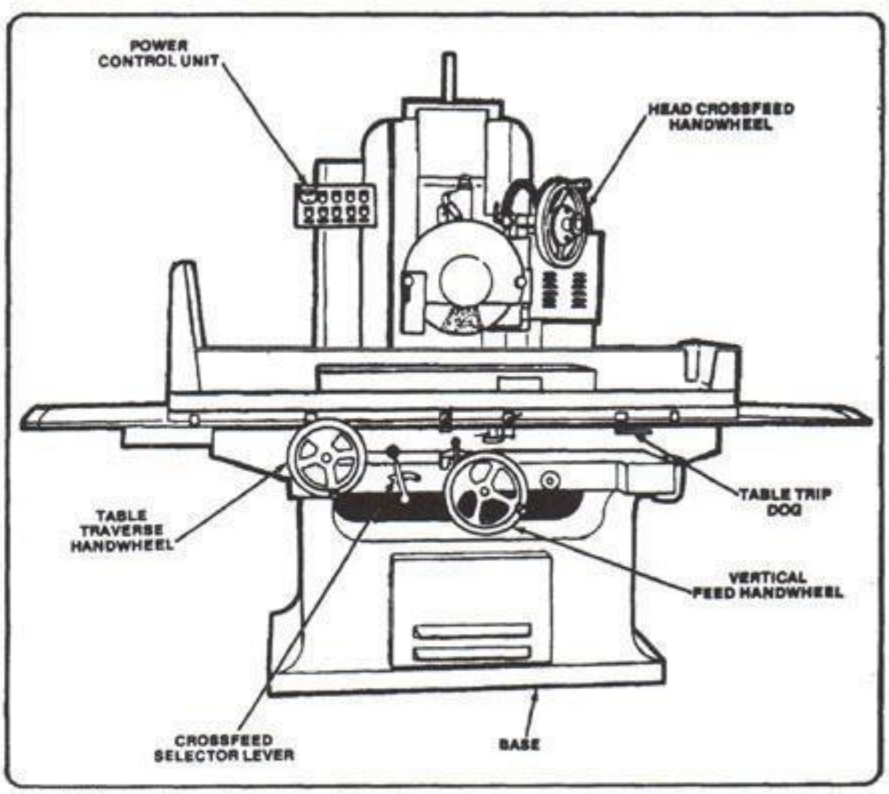


Figure 5-6. Reciprocating surface grinding machine

The grinding machine consists of a power driven grinding wheel spinning at the required speed and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the work piece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or table position is possible using a Vernier calibrated hand wheel, or using the features of numerical controls. Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases.

KINDS OF GRINDING:

1. Rough or non-precision grinding
2. Precision grinding

ROUGH OR NON PRECISION GRINDING

The common forms of rough grinding are snagging and offhand grinding, where the work is held in the operator's hand. The work is pressed hard against the wheel, or vice versa. The accuracy and surface finish obtained of secondary importance.

PRECISION GRINDING

This is concerned with producing good surface finish and high degree of accuracy. Yarn wheel or work both are guided in precise paths.

CENTRELESS GRINDERS

Centre less grinding is a method of grinding exterior cylindrical tapered and formed surfaces on work pieces that are not held and rotated on centres. The principle elements of an external centre less grinder are the grinding wheel, regulating or back up wheel and the work rest. Both wheels are rotated in the same direction. The work rest is located between the wheels. The work is placed upon the work rest and the latter together with the regulating wheel, is fed forward forcing the work against the grinding wheel. Centre less grinding may be done in one of the three ways

a) Through feed
b) In feed
c) End feed

SURFACE GRINDERS:

Surface grinding machines are employed to finish planes on flat surfaces. They are also capable of grinding irregular, curved, convex and concave surfaces. Conventional surface grinders may be divided into two classes: one class has reciprocating tables for work ground along straight lines, while the other covers the machines with rotating work tables continuous rapid grinding. Surface grinders may also are classified according to whether they have horizontal or vertical grinding wheel spindles.

Horizontal Spindle Reciprocating Table Surface Grinder:

- **Base:** The base has a column at the back for supporting the wheel head. The base also contains the drive mechanism.
- **Table:** The table is fitted to the saddle on carefully machined ways. It reciprocates along ways to provide the longitudinal feed. If slots are provided in the table surfaces for clamping work pieces directly on the table or for clamping grinding fixtures or a magnetic chuck;
- **Wheel Head:** The wheel heads are mounted on the column secured on the base. It has ways for the vertical slide which can be raised or lowered with the grinding wheel only manually by rotating a hand wheel to accommodate work pieces of different heights and to set the wheel for depth of cut.
- **Operation:** The work piece reciprocates under the wheel, and the wheel on the table beds axially between passes to produce a fine flat surface. Wheel down feed determines depth of cut and final height of the piece from the table to the wheel. The amount of feed must only be equal to a few hundredths of milling meters. For example steel is rough ground withadepthofcutbetween0.02and0.05mmandfinishgroundwithadepthofcutof 0.005 to 0.01mm.

Ex.No:22 **PLAIN SURFACE GRINDING**

AIM:

To finish the surface of the given specimen using surface grinding machine

TOOLS REQUIRED:

1. Magnetic power machine table
2. Vernier caliper(0-150mm)
3. Micrometer(0-25mm)
4. Aluminum oxide grinding wheel.

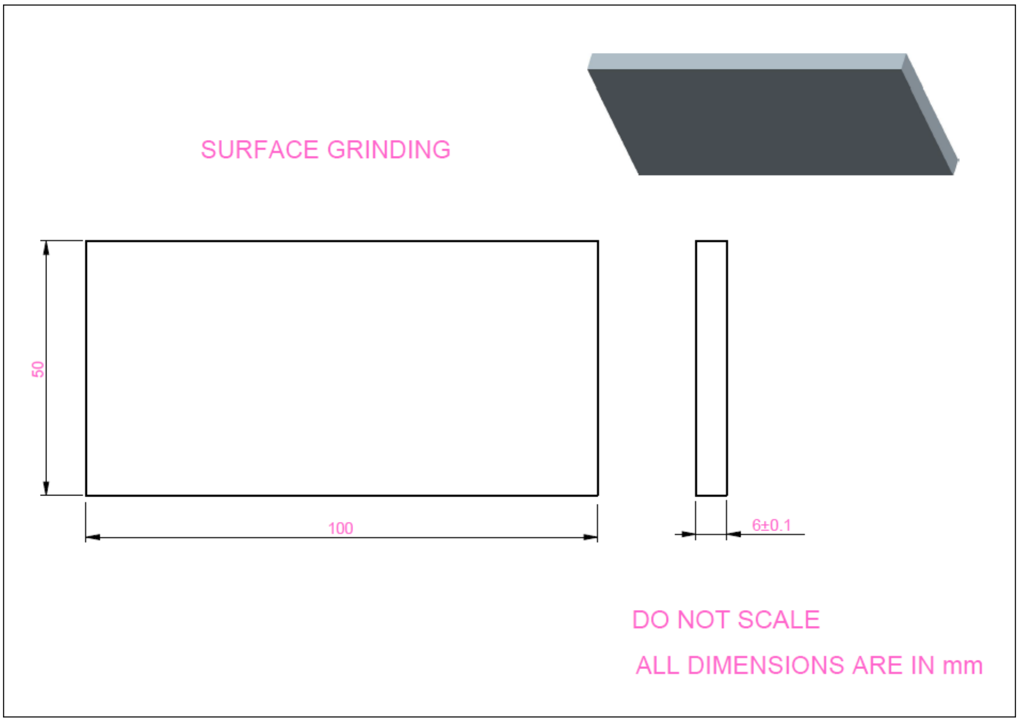
MATERIAL REQUIRED:

100mmX50mmX6mm M.S. flat

PROCEDURE

1. Check the dimensions of the given flat.
2. Mark the dimensions as per the given drawing using steel rule and scriber.
3. Clamp the work piece by means of a magnetic chuck.
4. Then start the machine with slow speed
5. The table is started to Reciprocate.
6. Then feed is given with minimum depth of cut.
7. Remove the job and check the dimensions.
8. Continue the steps to achieve the required dimensions.

DIAGRAM:



RESULT:

Thus the surface grinding operation is performed on the work piece.

Ex.No:23 **CYLINDRICAL GRINDING**

AIM:

To grind a given cylindrical work piece by using cylindrical grinding machine as per dimensions in the drawing

TOOLS REQUIRED:

1. Dog carrier
2. Vernier caliper
3. Vernier height gauge
4. Chuck key
5. Double ended spanner
6. V-block
7. Punch and Hammer

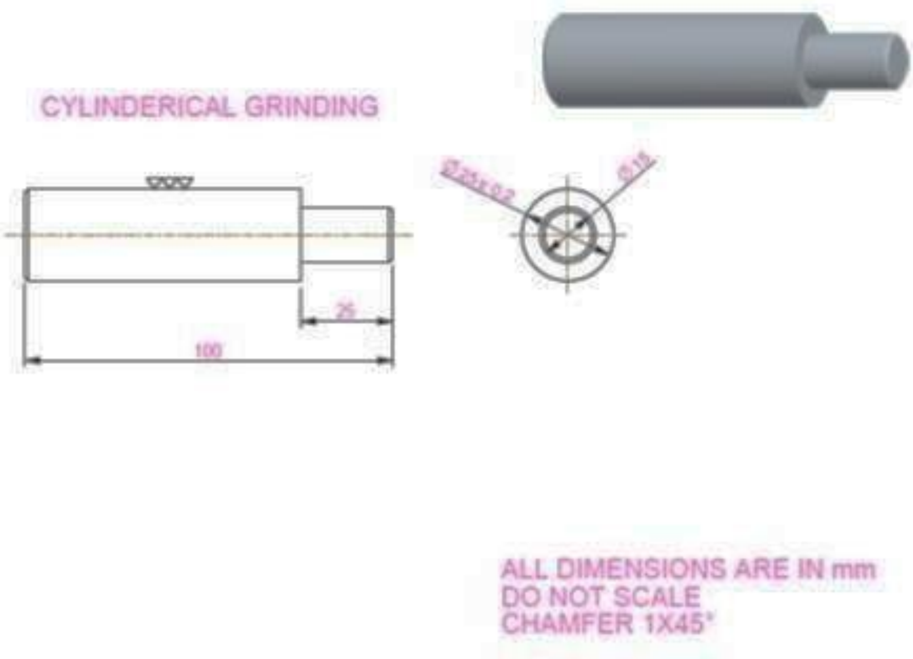
MATERIAL SUPPLIED:

1. Φ25mmX100mm cylindrical work piece
2. Material mild steel

PROCEDURE:

1. Check the dimensions of the given work piece.
2. Mark the dimensions as per the given drawing using steel rule and scriber.
3. Make drilling on both side of the marked center.
4. Hold the job in dog carrier and between the centers to remove the excess material from the work piece.
5. Grind the work piece of given dimension.
6. Check the dimension of the job.

DIAGRAM:



RESULT:

Thus the cylindrical grinding is operation performed on the work piece.

Ex.No:24 MEASUREMENT OF CUTTING FORCES IN MILLING/ TURNING PROCESS

AIM:

To measure the cutting forces for the given cutting conditions

TOOLS AND EQUIPMENTS REQUIRED:

1. Lathe
2. Lathe Tool Dynamometer

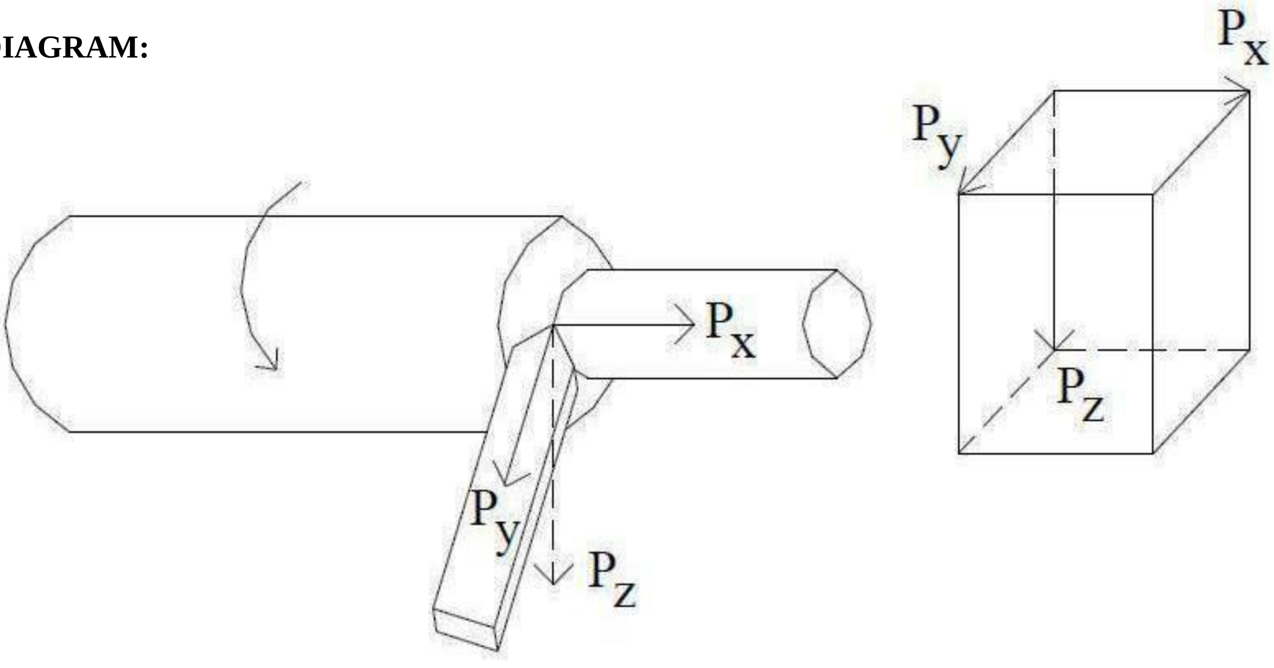
PROCEDURE:

1. The Lathe Tool Dynamometer is initially set to zero reading.
2. The known depth of cut is given and take the readings of Px and Pz force components from the Lathe Tool Dynamometer.
3. Calculate the resultant cutting force

$$P = \sqrt{Px^2 + Pz^2}$$

4. Repeat the same procedure to get few more readings and calculate the mean cutting force.
5. Repeat the same procedure for different depth of cuts

DIAGRAM:



NOTE:

1. Pz – the main or tangential component, determines the torque on main drive mechanism, the deflection of the tool and the required power. This component acts in the direction of the cutting speed.
2. Px – the axial component, acts in the direction of the tool traverse and it is at right angles to Pz. It contributes very little to the power consumption.
3. Py – the radial component, acts along the tool shank and perpendicular to the other two components. It has no share in the power consumption

TABULATION :

S.NO	DEPTH OF CUT-(mm)	HORIZONTAL COMPONENT P_X(Kg)	VERTICAL COMPONENT P_Z(Kg)	RESULTANT $P = \sqrt{Px^2 + Pz^2}$ (Kg)	AVERAGE (Kg)
1.	0.25				
2.	0.50				
3.	0.75				

RESULT:

Thus the cutting forces are measured for different depth of cuts