

Tambaram, —

**DEPARTMENT OF  
MECHANICAL ENGINEERING**

**ME8361 – MANUFACTURING TECHNOLOGY LABORATORY**

III SEMESTER - R 2013

**LABORATORY MANUAL**

Name : \_\_\_\_\_

Register No. : \_\_\_\_\_

Section : \_\_\_\_\_

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**VISION**

College of Engineering is committed to provide highly disciplined, conscientious and enterprising professionals conforming to global standards through value based quality education and training.

**MISSION**

- To provide competent technical manpower capable of meeting requirements of the industry
- To contribute to the promotion of Academic Excellence in pursuit of Technical Education at different levels
- To train the students to sell his brawn and brain to the highest bidder but to never put a price tag on heart and soul

**DEPARTMENT OF MECHANICAL ENGINEERING****VISION**

Rendering the services to the global needs of engineering industries by educating students to become professionally sound mechanical engineers of excellent caliber.

**MISSION**

To produce mechanical engineering technocrats with a perfect knowledge intellectual and hands on experience and to inculcate the spirit of moral values and ethics to serve the society

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

### 1. Fundamentals

To impart students with fundamental knowledge in mathematics and basic sciences that will mould them to be successful professionals

### 2. Core competence

To provide students with sound knowledge in engineering and experimental skills to identify complex software problems in industry and to develop a practical solution for them

### 3. Breadth

To provide relevant training and experience to bridge the gap between theory and practice which enable them to find solutions for the real time problems in industry and organization and to design products requiring interdisciplinary skills

### 4. Professional skills

To bestow students with adequate training and provide opportunities to work as team that will build up their communication skills, individual, leadership and supportive qualities and to enable them to adapt and to work in ever changing technologies

### 5. Life-long learning

To develop the ability of students to establish themselves as professionals in mechanical engineering and to create awareness about the need for lifelong learning and pursuing advanced degrees

## PROGRAMME OUTCOMES (POs)

On completion of the B.E. (Mechanical) degree, the graduate will be able

- a) To apply the basic knowledge of mathematics, science and engineering
- b) To design and conduct experiments as well as to analyze and interpret data and apply the same in the career or entrepreneurship
- c) To design and develop innovative and creative software applications
- d) To understand a complex real world problem and develop an efficient practical solution
- e) To create, select and apply appropriate techniques, resources, modern engineering and IT tools
- f) To understand the role as a professional and give the best to the society
- g) To develop a system that will meet expected needs within realistic constraints such as economical, environmental, social, political, ethical, safety and sustainability
- h) To communicate effectively and make others understand exactly what they are trying to tell in both verbal and written forms
- i) To work in a team as a team member or a leader and make unique contributions and work with coordination
- j) To engage in lifelong learning and exhibit their technical skills
- k) To develop and manage projects in multidisciplinary environments

**ME8361 - MANUFACTURING TECHNOLOGY LABORATORY****SYLLABUS****COURSE OBJECTIVES**

To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines, etc. and to equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

Machining and machining time estimations for:

1. Taper turning
2. External thread cutting
3. Internal thread cutting
4. Eccentric turning
5. Knurling
6. Square head shaping
7. Hexagonal head shaping

**COURSE OUTCOMES**

1. Able to produce a component by performing taper turning operation by compound rest method
2. Able to produce a component by performing taper turning operation by compound rest method
3. Able to produce a component by performing taper turning operation by tail stock offset method
4. Able to produce the component by performing external thread cutting operation using lathe
5. Able to produce the component by performing drilling, boring and thread cutting operation using lathe
6. Able to turn a given work piece eccentrically in a lathe machine as per the given dimensions
7. Able to make round work piece to square shape by using shaper
8. Able to make a round work piece to hexagonal shape by using shaper
9. Able to produce the component by performing knurling and grooving operation using lathe
10. Able to machine the work piece to the given dimensions using capstan lathe

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**Expt. No.01****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 these 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.

When the workpiece is rotated about an axis and the tool is traversed in a definite path relative to the axis, a surface of revolution is generated. When the tool path is parallel to the axis, the surface generated is a cylinder as in straight turning or boring operations. Similarly, planes may be generated by a series of straight cuts without rotating the workpiece as in shaping and planning operations (Fig.3).

In shaping the tool is reciprocating and the work piece is moved crosswise at the end of each stroke. Planning is done by reciprocating the work piece and crosswise movement is provided to the tool.

Surface may be machined by the tools having a number of cutting edges that can cut successively through the work piece materials. In plane milling, the cutter revolves and moves over the work piece as shown Fig. 4. The axis of the cutter is parallel to the surface generated.

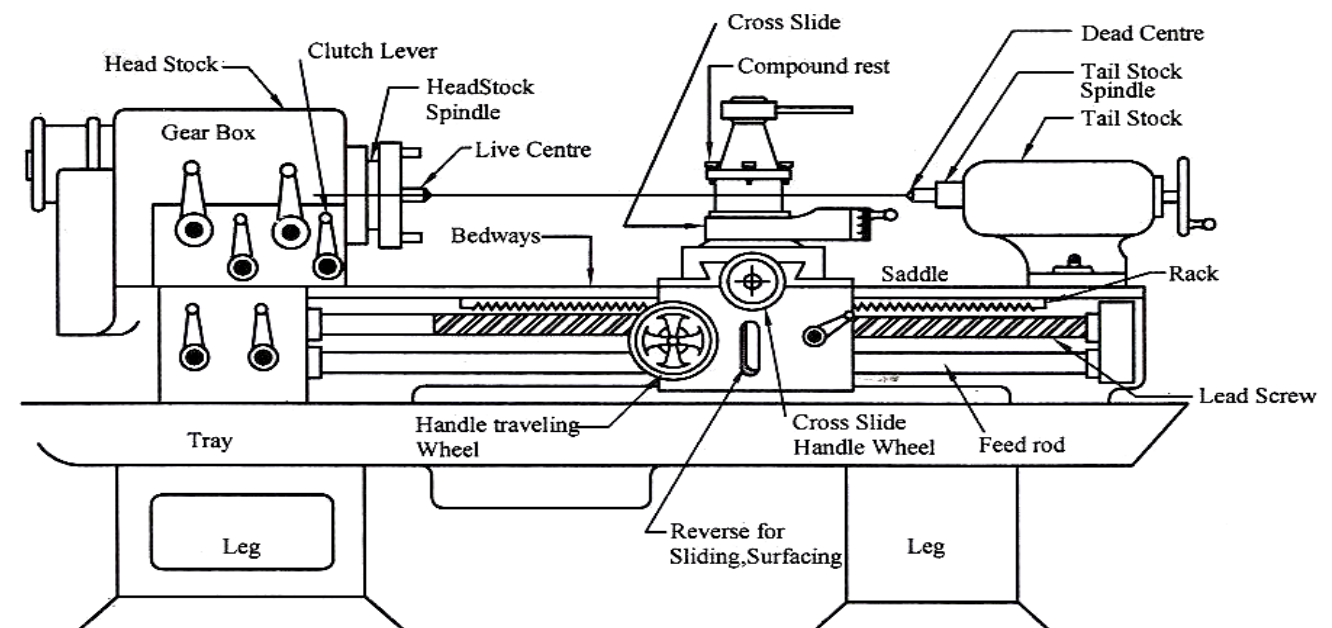
Similarly in drilling, the drill may turn and be fed into the work piece or the work piece may revolve while the drill is fed into it (Fig.5).

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 only 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 withdraw from such a contact. It operates on bed ways between the headstock and tail stock.

### Saddle:

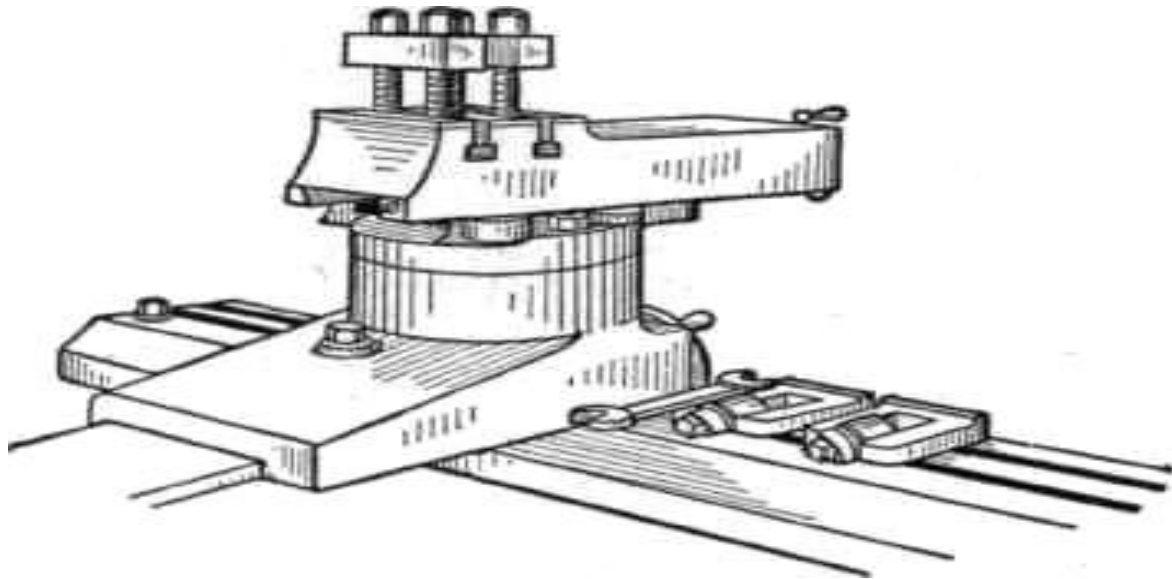
It is an 'H' shaped part fitted on the lathe bed. There is a hand wheel to move it on the bed way. Cross slide, compound rest, tool post is fitted on this saddle.

### 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.

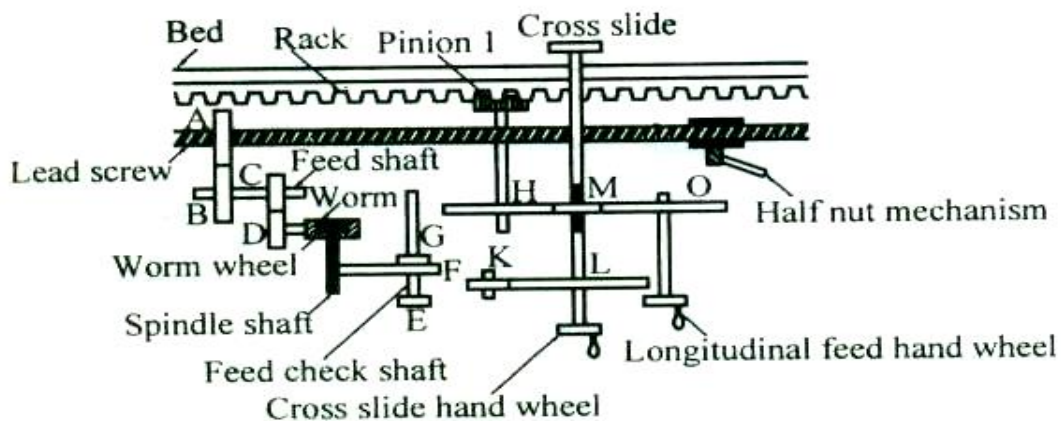


### Tool post:

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.

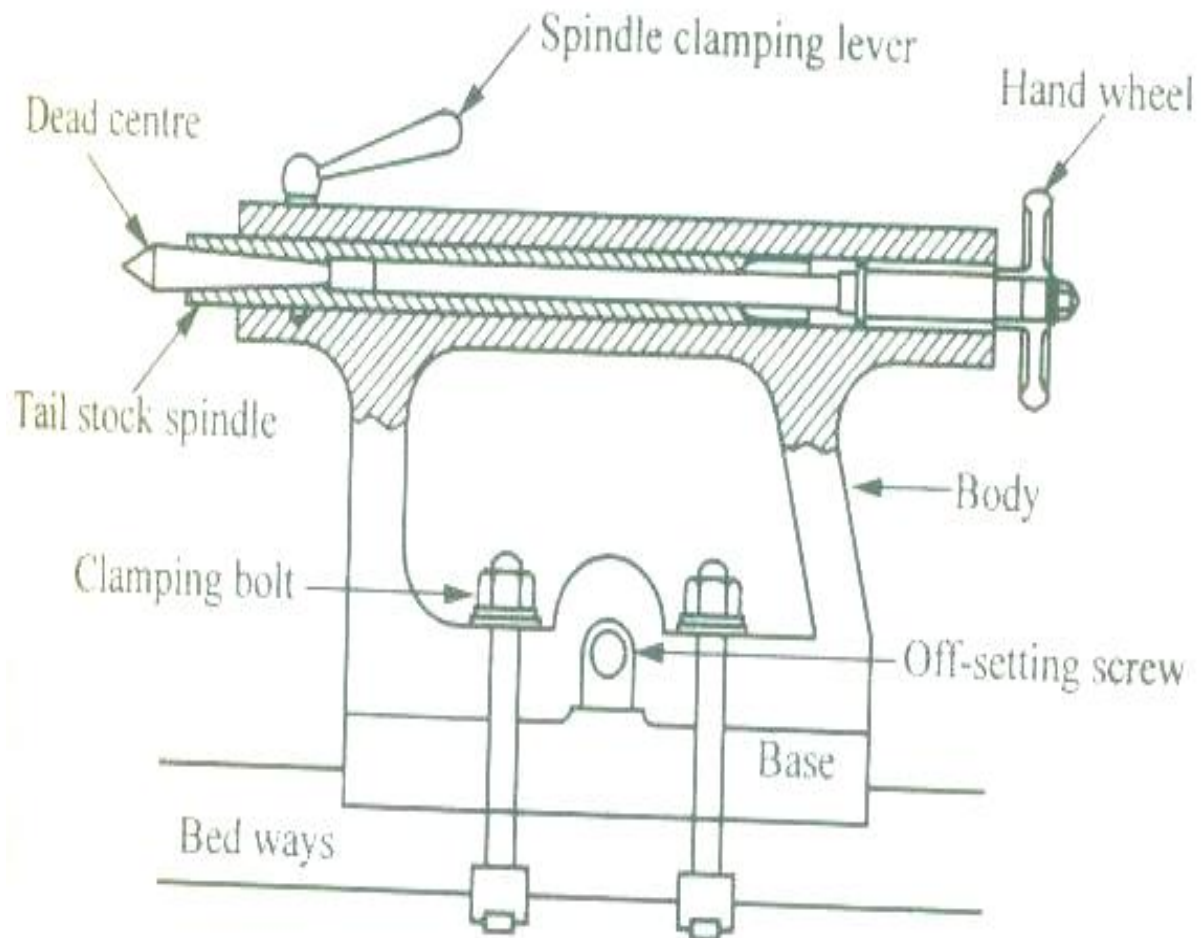


### Lead screw:

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:

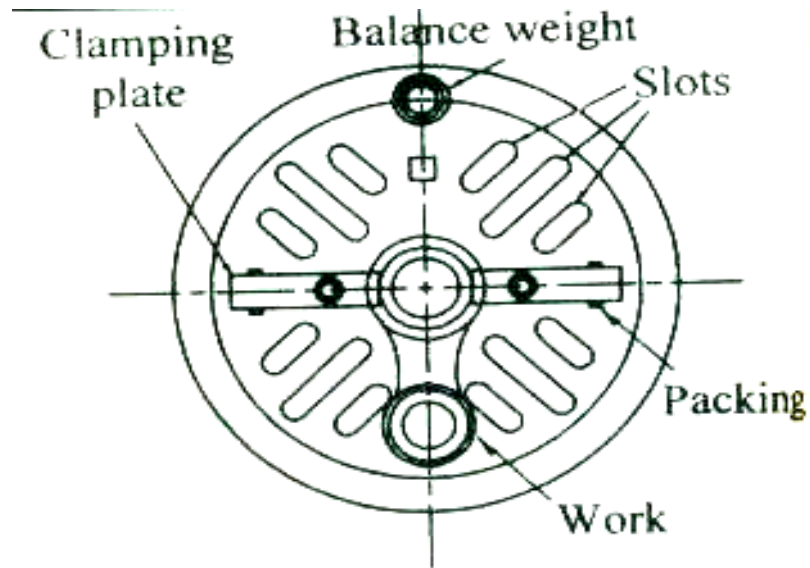
#### Lathe centers:

They are used to support work. It has two categories of centers. Live center is one which is fitted in the headstock 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.

Face plate:



Lathe carriers or dogs:



Steady rest:

Clamped to the lathe ways, it uses adjustable fingers to contact the work piece and align It Can be used in place of tailstock or in the middle to support long or unstable parts being machined.

Mandrel:

Mandrel used to hold hollow jobs.

Follower rest:

Bolted to the lathe carriage, it uses adjustable fingers to bear against the work piece opposite the cutting tool to prevent deflection.



### 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:

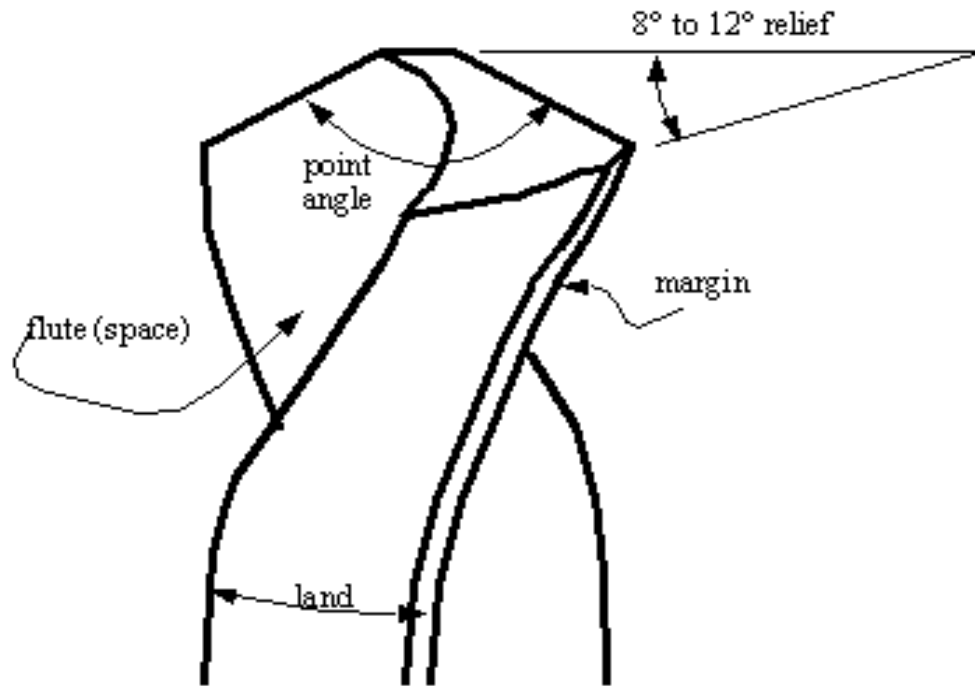
It is used for jobs which require both convex and concave turning.

### 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.

### Tool materials:

The single point cutting tools are made of high speed steel(H.S.S). The main alloying elements in 18-4-1 HSS tools are 18% tungsten, 4% chromium and 1% vanadium. 5 to 10% cobalt is also added to improve the heat resisting properties of the tool. General purpose hand cutting tools are usually made from carbon steel or tool steel. Carbide tipped tools fixed in tool holders, are mostly used in production shops.

### Cutting tool angles:

#### Top rake angle (back rake angle):

If the slope is given to the face or surface of the tool and if this slope is along the tools length then it is called top rake angle. It is usually from 15° to 20°.

#### Side rake angle:

If the slope is given to the face or top of the tool along the tools width then it is called side rake angle. It lies between 6° and 15°.

#### Clearance angle (relief angle):

Types: 1. Side clearance angle 2. End clearance angle.

They are provided to keep surface of the tool clear of the work piece.



### Cutting edge angle:

Types: 1. Side cutting edge angle – (generally  $15^\circ$ ) it is an angle, the side cutting edge makes with the axis of the tool 2. End cutting edge angle – (from  $7^\circ$  to  $15^\circ$ ) it is an angle made by the end cutting edge with the width of the tool.

### Lip angle (cutting angle):

It is the angle between the face and the end surface of the tool.

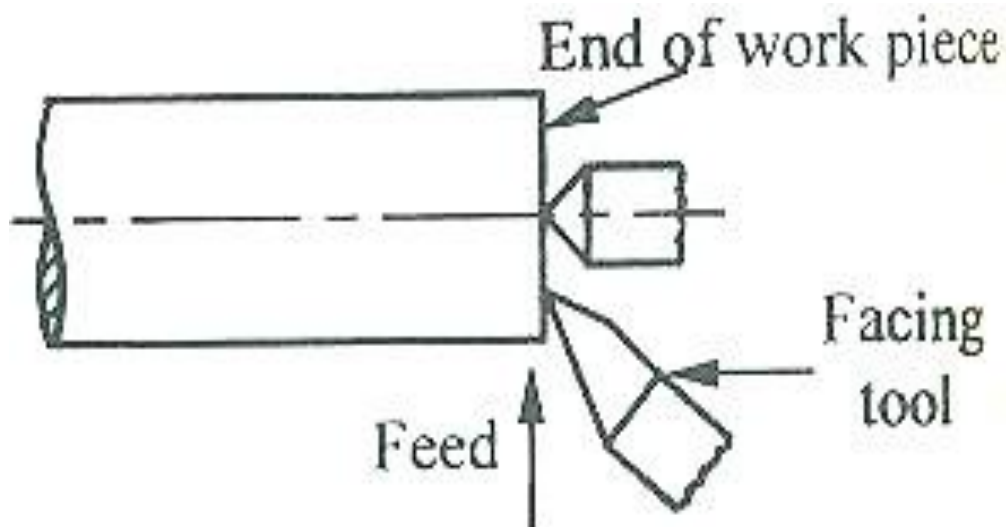
### Nose angle:

It is the angle between the side cutting edge and end cutting edge.

### Lathe operations:

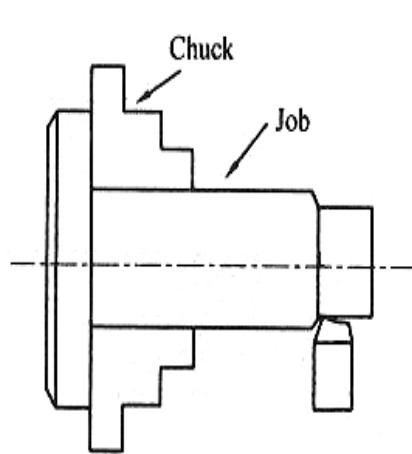
#### Facing:

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.

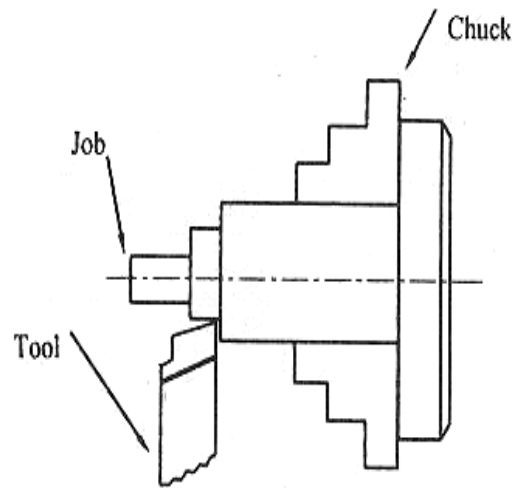


#### Plain Turning:

It is done for reducing the diameter of the work piece. A cutting tool with  $70^\circ$  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.



**Plain Turning**  
**R.H Tool**



**Step turning**  
**R.H Tool**

### 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:

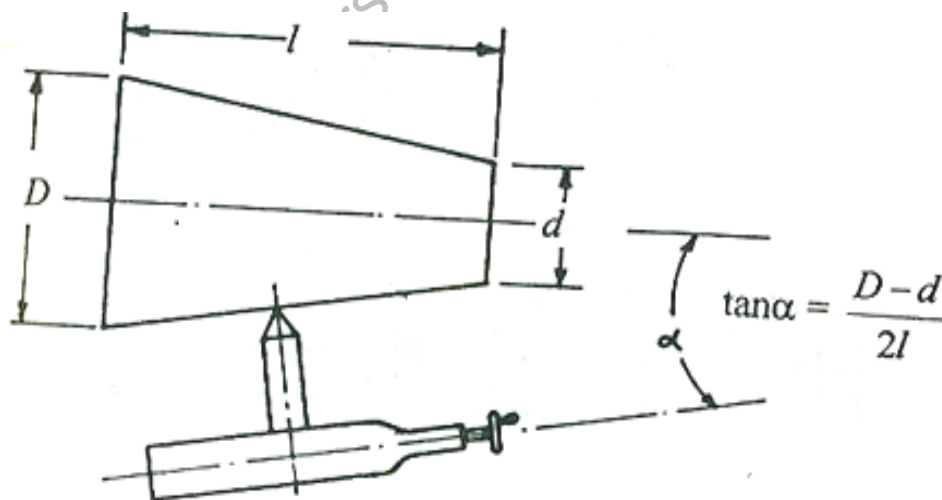
It is different from the turning operation. Taper is defined as uniform change in the diameter of a work piece measured along its length.

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.

### Cutting Speed:

It is the peripheral speed of the work past the cutting tool. It is the speed at which metal is removed by the tool from the work piece. It is expressed in meter / minute. Cutting speed=  $(\pi \times \text{diameter} \times \text{R.P.M})/1000 = \pi DN/1000$  in m/min

D – Diameter in mm

N – Spindle speed in rpm

### Feed:

It is defined as the rate of tool travel across a surface cutting it. It is the distance of the tool advances for each revolution of the work piece. It is expressed in mm/revolution.

### Depth of Cut:

It is the perpendicular distance measured from the machined surface to the uncut surface of work. It is expressed in mm.

Depth of cut=  $(d_1 - d_2)/2$

$d_1$  - diameter of work before machining

$d_2$  - diameter of work after machining

**Expt. No.02****TAPER TURNING USING COMPOUND REST****METHOD****Aim:**

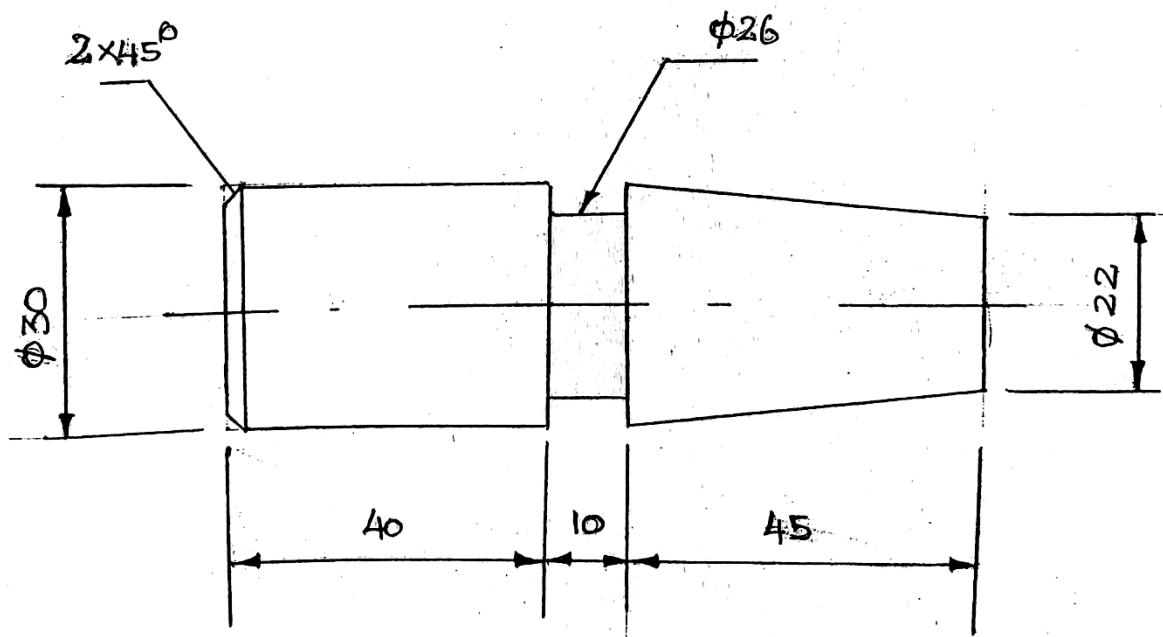
To produce the component by performing taper turning using lathe

**Materials required:**

Mild steel  $\Phi$  32 mm X 100 mm long

**Tools required:**

1. Chuck key
2. Tool post spanner
3. Vernier caliper
4. Steel rule
5. Single point cutting tool

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. Hold the workpiece in the chuck and tight it properly.
3. Clamp the tool on post properly and check the centre of work piece with cutting tool tip.
4. Do the facing operation by giving cross feed to the cross slide and reduce length.

5. Do the turning operation by giving longitudinal feed to the carriage and reduce the diameter of the work piece.
6. Two or three pass can be given for turning operation.
7. Remove the work piece and hold in chuck on other side and do the turning operation for the remaining portion of the work piece.
8. Calculate the taper angle and swivel the compound rest and clamp it properly.
9. Do the taper turning operation by giving angular feed to the compound rest as per the dimension.
10. Do the facing operation and get the required length.
11. Remove the component carefully and check the dimension.

**Result:**

Thus the component is produced as per the given drawing using lathe.

**Outcome:**

Able to produce a component by performing taper turning operation by compound rest method

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Viva - voce

1. What is meant by lathe?
2. What are the various operations can be performed on a lathe?
3. What are principle parts of the lathe?
4. What are the types of headstock?
5. What are the various parts mounted on the carriage?
6. What are the four types of tool post?
7. What is meant by an apron?
8. What are the two specification of lathe?
9. What are the types of lathe?
10. What is meant by semi-automatic lathe?
11. What is meant by capstan lathe?
12. Write down the formula used for taper turning by compound rest method.
13. What is the purpose of compound rest?
14. How to give angular feed in lathe
15. What is the purpose of three jaw chuck?

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**Expt. No.03****TAPER TURNING BY TAIL STOCK OFFSET****METHOD****Aim:**

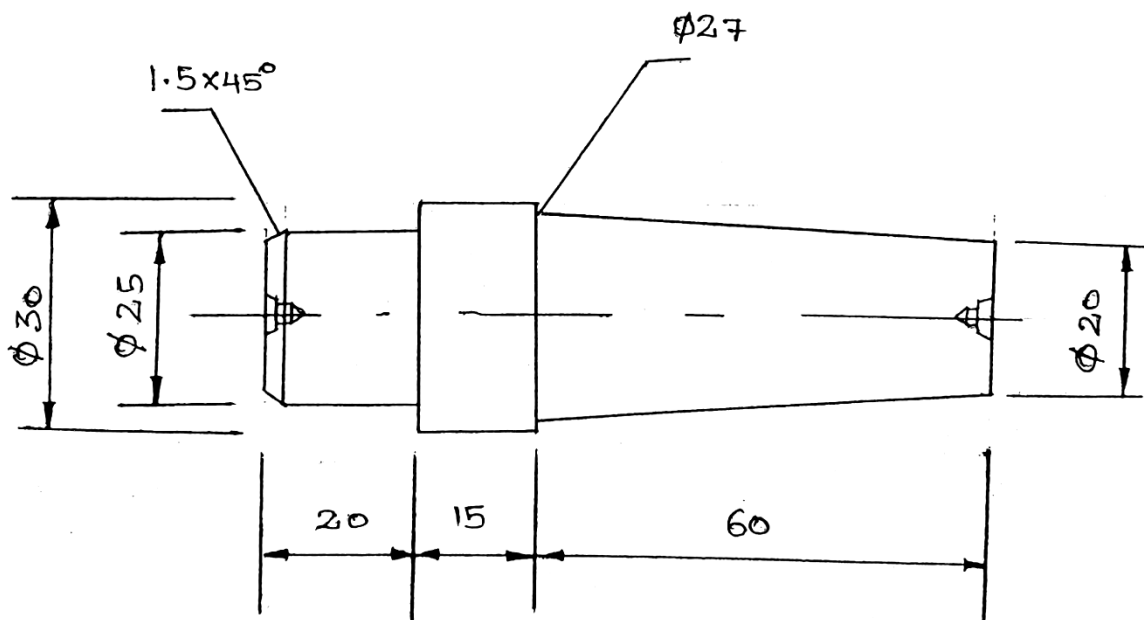
To produce the component by performing taper turning using lathe

**Material required:**

Mild steel  $\Phi$  32 mm X 100 mm long

**Tools required:**

1. Chuck key
2. Tool post spanner
3. Vernier caliper
4. Steel rule
5. Single point cutting tool
6. Revolving centre
7. Drill chuck with centre drill bit
8. Catch plate with dog carrier

**Specimen drawing:**

All dimensions are in mm

### Procedure:

1. Check the size of raw material given and ensure the size.
2. Held the work piece in the chuck and tight it properly.
3. Clamp the tool on tool post properly and check the centre of work piece with cutting tool tip.
4. Do the facing operation by giving cross feed to the cross slide and reduce the length.
5. Do the turning operation by giving longitudinal feed to the carriage and reduce the diameter of the work piece.
6. Two or three passes can be given for turning operation.
7. Remove the work piece and hold in chuck on other side. Does the turning operation for the remaining portion of the work piece also do the facing operation and get the required length.
8. Make a centre drilling operation on both sides by tail stock.
9. Calculate the offset distance and offset the tail stock from the lathe axis.
10. Hold the work piece between lathe centers on both side using catch plate with dog carrier.
11. Do the taper turning operation by giving longitudinal feed to the carriage as per the dimension.
12. Remove the component carefully and check the dimension.

### Result:

Thus the component is produced as per the given drawing using lathe.

### Outcome:

Able to produce a component by performing taper turning operation by tail stock offset method



Viva - voce

1. Define – Conicity
2. What are the different operations performed on the lathe?
3. What are the holding devices?
4. What are the various feed mechanisms used for obtaining automatic feed?
5. What is copying lathe?
6. What are the advantage of capston lathe & turret lathe?
7. What is meant by tooling?
8. What are the three stage of a tool-layout?
9. What are the different drives used in copying lathe?
10. What are the two specifications of capstan and turret lathe?
11. What are the methods used for taper turning in lathe?
12. What are various feeds in lathe?
13. Which method is suitable for steep turning?
14. Which method is suitable for taper turning on lengthy workpiece?
15. What is meant by lead screw?

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**Expt. No.04****EXTERNAL THREAD CUTTING****Aim:**

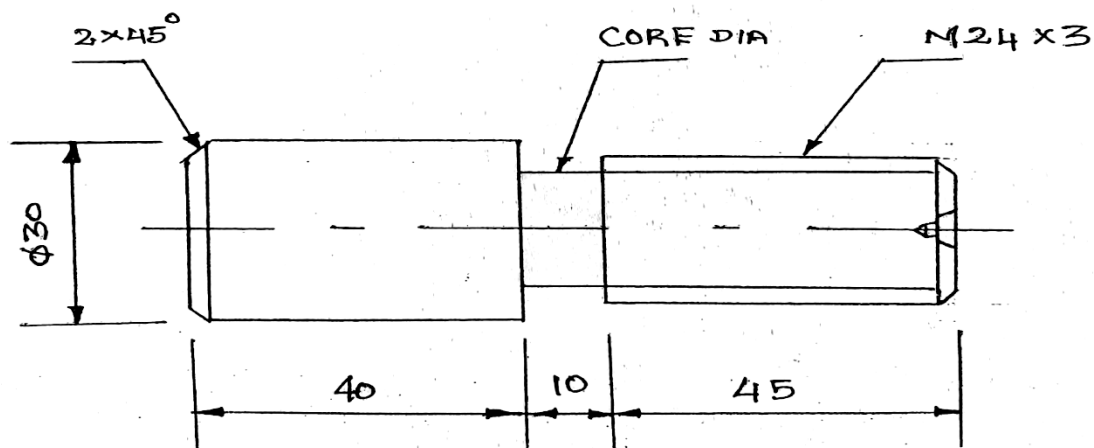
To produce the component by performing threads cutting operation using lathe

**Material required:**

Mild steel  $\phi$  32 mm X 100 mm long

**Tools required:**

1. Chuck key
2. Tool post spanner
3. Vernier caliper
4. Steel rule
5. Single point cutting tool
6. V thread cutting tool
7. Pitch gauge
8. Grooving tool
9. Drill chuck with centre drill bit

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. Hold the work pieces in the chuck and tight it properly.
3. Clamp the tool on tool post properly and check the centre of work piece with cutting tool tip.
4. Do the facing operation by giving cross feed to the cross slide and reduce the length.

5. Do the turning operation by giving longitudinal feed to the carriage and reduce the length.
6. Two or three pass can be given for the turning operation.
7. Remove the work piece and hold in chuck on the other side and do the turning operation for the remaining work piece.
8. Engage the back gear mechanism to reduce the speed of the work piece.
9. Check the pitch required, calculate the tumbler gear, and engage it with head stock.
10. Move the carriage towards tail stock and make a mark on the dial.
11. Give small depth of cut and engage the half nut so that the carriage will move automatically towards head stock and cut the v-thread on the work piece.
12. After reaching the required length of thread, release the tool by rotating cross slide in opposite to the depth of cut by counting the number of rotation.
13. Move the carriage towards tail stock, give depth of cut and engage the half nut.
14. Repeat the procedure to produce complete form of v-thread. After finishing remove the work piece from the chuck.

### Result:

Thus the component is produced as per the given drawing using lathe.

### Outcome:

Able to produce the component by performing external thread cutting operation using lathe

Viva - voce

1. What are the components that can be turned on a copying lathe?
2. What is meant by shaper?
3. What are the four important parts of a shaper?
4. How the feed & depth of cut is given to the shaper?
5. What are the four-shaper specifications?
6. How does the planer differ from the shaper?
7. What is the use of planer?
8. What are the various types of planners?
9. Name the various parts of a double housing planer?
10. What are the four specifications of planer?
11. Write down different types of thread.
12. Define – Pitch
13. What is meant by knurling?
14. Distinguish between square and V type thread
15. Write down the formula used for pitch calculation.

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## Expt. No.05      DRILLING, BORING AND INTERNAL THREAD

### CUTTING

Aim:

To produce the component by performing drilling, boring and thread cutting using lathe

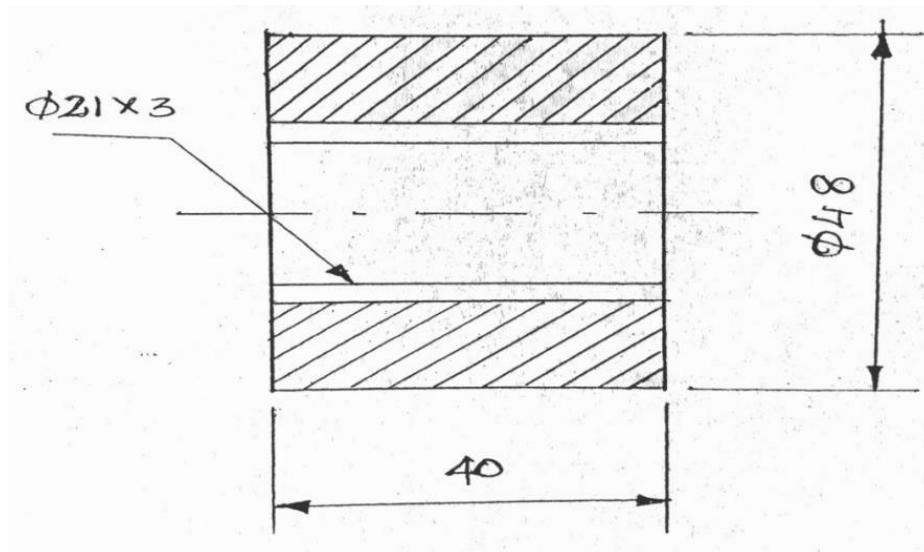
Material required:

Mild steel  $\Phi$  50 mm X 45 mm long

Tools required:

1. Chuck key
2. Tool post spanner
3. Vernier caliper & Steel rule
4. Single point cutting tool & Boring tool
5. Drill chuck with drill bits
6. Internal thread cutting tool

Specimen drawing:



All dimensions are in mm

Procedure:

1. Check the size of raw material given and ensure the size.
2. Hold the workpiece in the chuck and tight it properly.
3. Clamp the tool on tool post properly and check the centre of work piece with cutting tool tip.
4. Do the facing operation by giving cross feed to the cross slide and reduce the length.
5. Hold the drill bit on the tail stock and unclamp the tail stock, then move it towards the head stock and ensure the centre coincidence with work piece centre.

6. Start the motor and give depth of cut to the drill bit by rotating the tail stock wheel and make complete hole.
7. Clamp the boring tool on the tool post to perform the boring operation.
8. Clamp the internal thread tool on the tool post to perform internal threading operation,
9. Engage the back gear mechanism to reduce the speed of the work piece.
10. Check the pitch required, calculate the tumbler gear and engage it with head stock.
11. Move the carriage towards tailstock and make marking on the dial.
12. Give small depth of cut and engage the half nut so that the carriage will move automatically towards headstock and cut the v thread on the work piece.
13. Release the tool by rotating cross slide in opposite to the depth of cut by counting number of rotation after reaching the required length of thread.
14. Move the carriage toward the tail stock and give depth of cut and engage the half nut.
15. Repeat the procedure to produce complete form of v thread. After finishing remove the work piece from the chuck.

### Result:

Thus the component is produced as per the given drawing using lathe

### Outcome:

Able to produce the component by performing drilling, boring and thread cutting operation using lathe

1. What is meant by drilling?
2. What is meant by gang -drilling machine?
3. What are the specifications of drilling machine?
4. What are the machining operations that can be performed on a drilling machine?
5. What are the different ways to mount the drilling tool?
6. What is meant by broaching?
7. What are the specifications of a broaching machine?
8. What are the advantages and limitation of broaching?
9. What are the different operations that can be performed on a broaching machine?
10. What is meant by boring?
11. Differentiate between drilling and boring
12. What is meant by counter boring?
13. What is meant by counter sinking?
14. Which type of tool used for boring?
15. What is meant by pitch circle diameter?

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**Expt. No.06****ECCENTRIC TURNING****Aim:**

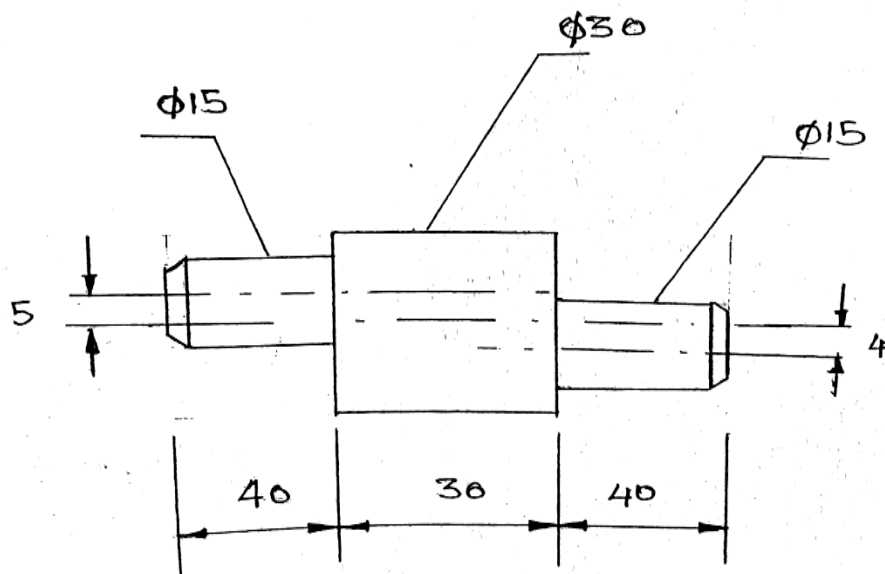
To turn a given work piece eccentrically in a lathe machine as per the given dimensions

**Material required:**

Mild steel  $\Phi$  32 mm X 75 mm long

**Tools required:**

1. Steel rule
2. Dot punch
3. Ball pen hammer
4. Single point cutting tool
5. Surface gauge
6. Drill bit
7. Drill chuck
8. Boring tool

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. The work piece is fixed in the four jaw chuck using surface gauge.
3. The cutting tool is fixed in the tool post to the lathe axis.
4. Facing operation has been done on both sides of given work pieces.
5. Marking and punching is to be done on the given work pieces as per the dimension.



6. Then the work piece is fixed in the chuck such that the offset point coincides with spindle axis.
7. Using the turning tool, turning operation has been performed.
8. The same procedure is also carried out to the other side of the work piece for the given offset distance.
9. Thus the eccentric turning would be finished.

**Result:**

Thus the work piece is turned eccentrically as per the given dimensions.

**Outcome:**

Able to turn a given work piece eccentrically in a lathe machine as per the given dimensions

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Viva - voce

1. What is meant by eccentricity?
2. What is meant by effect of back rake angle? Mention the types.
3. What is meant by side rake angle? Mention its effects.
4. What are all the conditions for using positive rake angle?
5. When will the negative rake angles be used?
6. Define – Orthogonal cutting
7. What is meant by cutting force?
8. What is meant by chip thickness ratio?
9. What are the purposes of chip breakers?
10. Define – Machinability of metal
11. Define – Oblique cutting
12. Differentiate between orthogonal and oblique cutting.
13. Which type of chuck used for eccentric turning?
14. What are the applications of eccentric components?
15. What is meant by tool signature?

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**Expt. No.07****SQUARE HEAD SHAPING****Aim:**

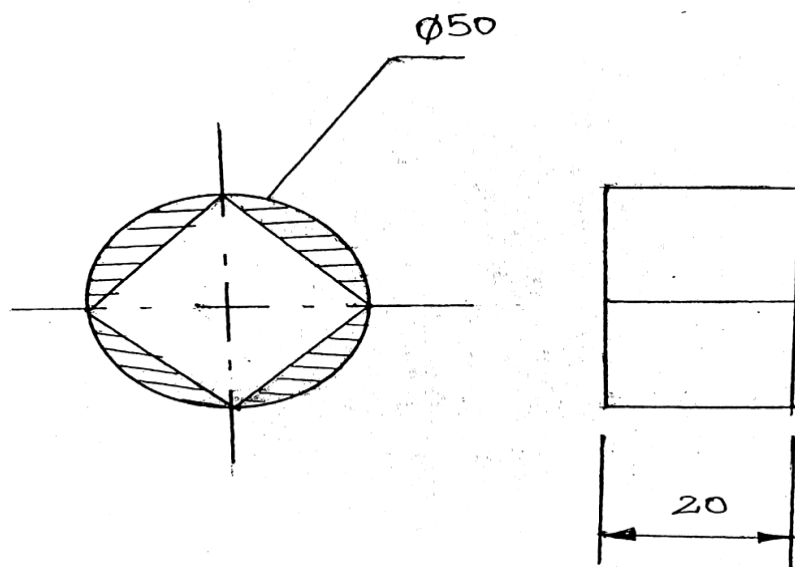
To make round work piece to square by using shaper

**Material required:**

Mild steel  $\Phi$  50 mm x 25 mm long

**Tools required:**

Steel rule, dot punch, hammer, vernier height gauge, T-square, scribe, surface plate, single point cutting tool, tool holder.

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. The work piece is fixed in the three jaw chuck.
3. The cutting tool is fixed in the tool post to the lathe axis.
4. Facing operation has been done on both sides of given work pieces.
5. Chalk is applied uniformly on the face of the work piece.
6. Marking and punching is to be done on the given work pieces as per the dimension.
7. The cutting tool is fixed in the tool holder in shaper machine.
8. The work piece is fixed in the machine vice, then switch on the machine.

9. At the end of each stroke give the feed to the work piece.
10. Shaping operation has been done on four sides in the work piece till the round work piece is turned into square shaped as per the given dimension.

### Result:

Thus the round work piece is machined to square work piece by shaper machine.

### Outcome:

Able to make round work piece to square shape by using shaper

Viva - voce

1. What is meant by shaper?
2. What are the various types of shaper?
3. What are the specifications of shaper?
4. What are the operations of shaper?
5. What is the application of square head?
6. What is meant by indexing?
7. What are the three types dividing heads?
8. What is cam milling?
9. What are the different types of thread milling?
10. What are the other forming methods for manufacturing gears?
11. Write any ten nomenclature of plain milling cutter?
12. What are the various milling operations?
13. What are the advantages of milling process?
14. What are the down milling processes?
15. What is the various type of milling attachment?

**Expt. No.08****HEXAGONAL HEAD SHAPING****Aim:**

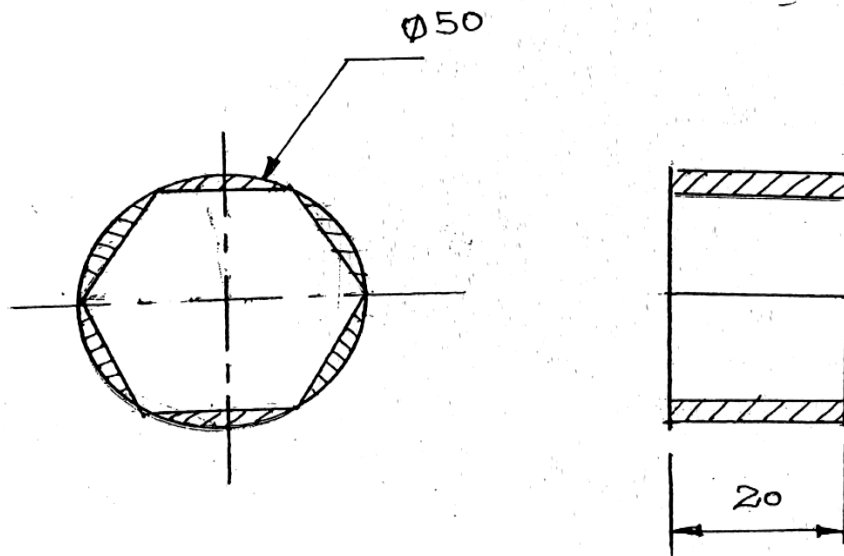
To make a round work piece to hexagonal shape by using shaper

**Material required:**

Mild steel rod size of dia. 32 mm and length 50 mm

**Tools required:**

Steel rule, dot punch, hammer, vernier height gauge, T-square, scribe, surface plate, single point cutting tool, tool holder.

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. The work piece is fixed in the three jaw chuck.
3. The cutting tool is fixed in the tool post to the lathe axis.
4. Facing operation has been done on both sides of given work pieces.
5. Chalk is applied uniformly on the face of the work piece.
6. Marking and punching is to be done on the given work pieces as per the dimension.
7. The cutting tool is fixed in the tool holder in shaper machine.
8. The work piece is fixed in the machine vice, then switch on the machine.

9. At the end of each stroke give the feed to the work piece.
10. Follow the same procedure to the other side of the work piece.
11. Shaping operation has been done on six sides in the work piece till the round work piece is turned into hexagonal shaped as per the given dimension.

### Result:

Thus the round work piece is machined to hexagonal shape by shaper machine.

### Outcome:

Able to make a round work piece to hexagonal shape by using shaper

Viva-voce
-----------

1. What is the function of cutting fluids?
2. What are the properties of cutting fluid?
3. What are the causes of wear?
4. What are the specifications of the milling machine?
5. What are the various movements of universal milling machine table?
6. Distinguish between plain and universal milling machine?
7. What are the cutter holding devices?
8. What are the various type of milling attachment?
9. Write any ten nomenclature of plain milling cutter?
10. What are the advantages of milling process?
11. What are the applications of hexagonal head?
12. Differentiate shaper from planner.
13. What are the operations of planner?
14. What are the work holding devices used in shaper?
15. What are the tool holding devices used in shaper?

**Expt. No. 9****STUDY OF WELDING****Aim:**

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

**Introduction:**

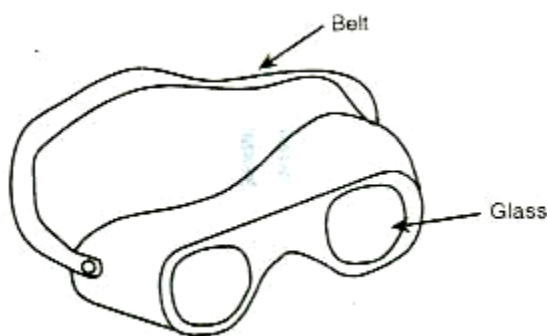
Welding is the process of joining two metal plates using a joining material by heat. It is commonly used to join metal plates in making boilers, vessels, furnitures, automobile parts, etc.

**Safety equipments and tools:****Welding goggles:**

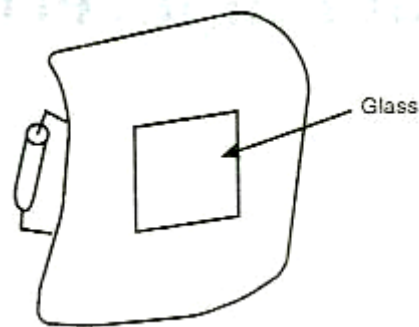
Goggles with glasses are used to protect the eyes of the welder from the light sparks produced during welding.

**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.



Welding goggles



Face shield

**Hand gloves:**

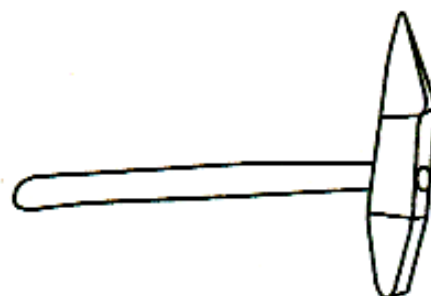
It is used to protect the hands of the welder from the effect of ultra violet rays, infra red rays, heat and sparks.

**Chipping Hammer:**

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



Hand gloves



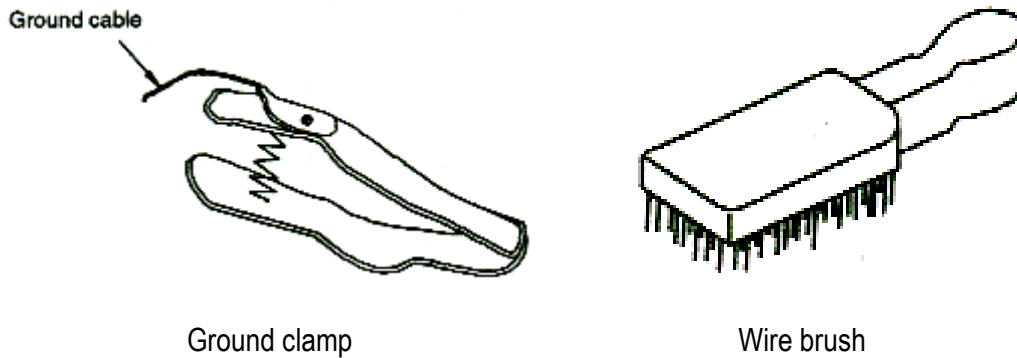
Chipping hammer

**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.

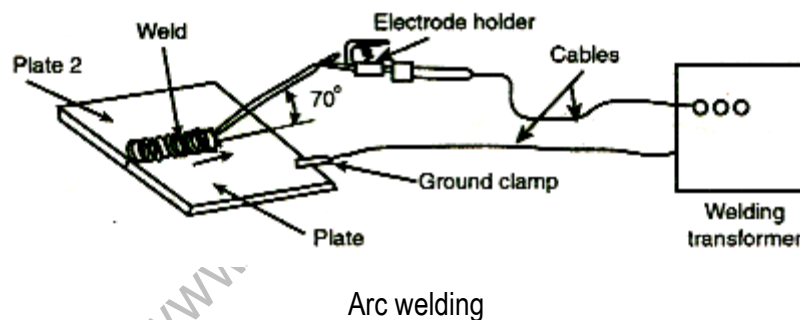
**Types of Welding:**

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.



**Expt. No. 10****SINGLE V BUTT JOINT****Aim:**

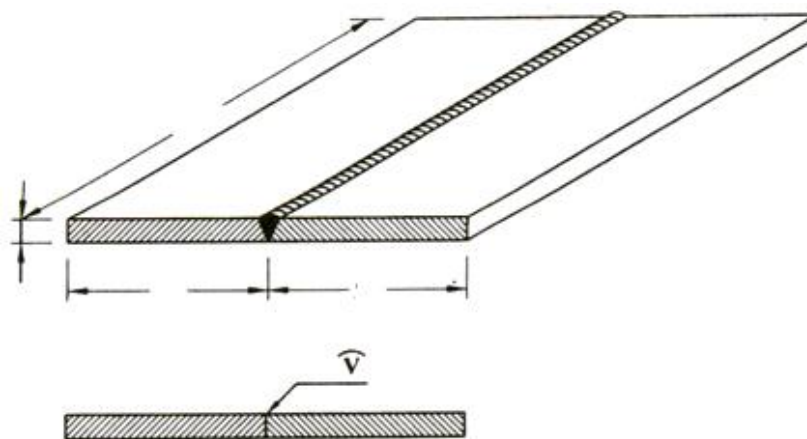
To join two given metal plates by a single 'V' butt joint in arc welding

**Materials required:**

MS flat: Length = mm  
Breadth = mm  
Thickness = mm

**Tools Required:**

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

**Diagram:**

**Welded Joint Representation**

All dimensions are in 'mm'

**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.

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**Result:**

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

**Outcome:**

Able to join two given metal plates by a single 'V' butt joint in arc welding.

**Expt. No. 11****DOUBLE V BUTT JOINT****Aim:**

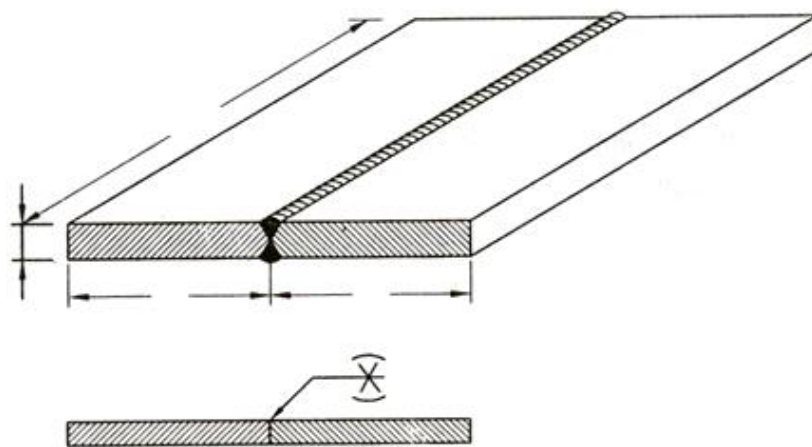
To join two given metal plates by a double 'V' butt joint in arc welding

**Materials required:**

MS flat: Length = mm  
Breadth = mm  
Thickness = mm

**Tools Required:**

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

**Diagram:**

**Welded Joint Representation**

All dimensions are in 'mm'

**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 is clamped 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.

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**Result:**

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

**Outcome:**

Able to join two given metal plates by a double 'V' butt joint in arc welding.

**Expt. No. 12****LAP JOINT****Aim:**

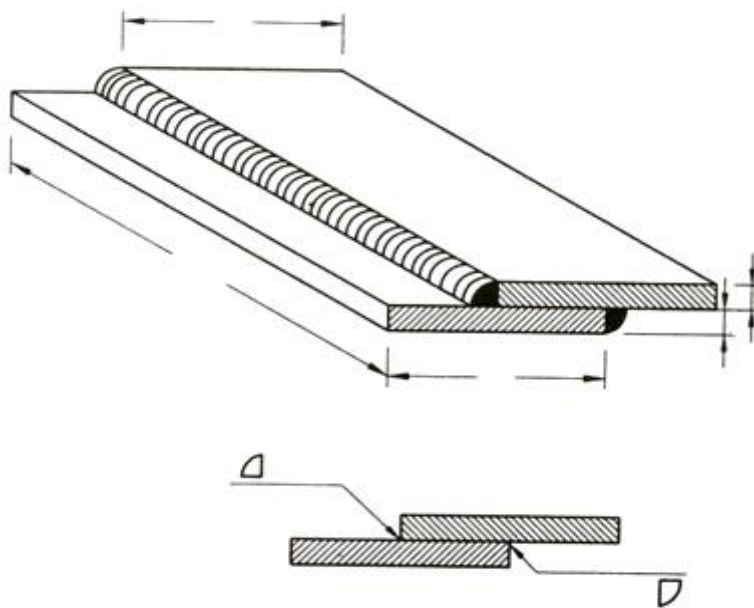
To join two given metal plates by a lap joint in arc welding

**Materials required:**

MS flat: Length = mm  
Breadth = mm  
Thickness = mm

**Tools Required:**

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

**Diagram:**

**Welded Joint Representation**

All the dimensions are in 'mm'

**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.

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### Result:

Thus the two metal plates are welded in lap joint.

### Outcome:

Able to join two given metal plates by a lap joint in arc welding.

**Expt. No. 13****TEE FILLET JOINT**

**Aim:**

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

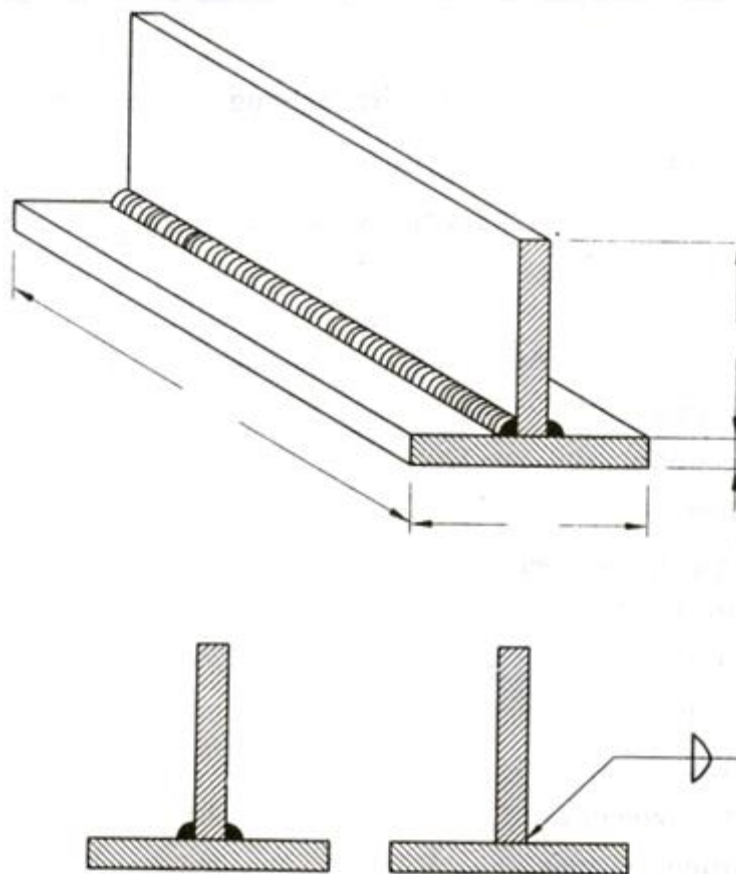
**Materials required:**

MS flat: Length = mm  
Breadth = mm  
Thickness = mm

**Tools Required:**

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

**Diagram:**



**Welded Joint Representation**

All dimensions are in 'mm'

### 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.

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### Result:

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

### Outcome:

Able to join two given metal plates by a tee fillet joint in arc welding.



**Expt. No. 14****GAS WELDING PRACTICE****Aim:**

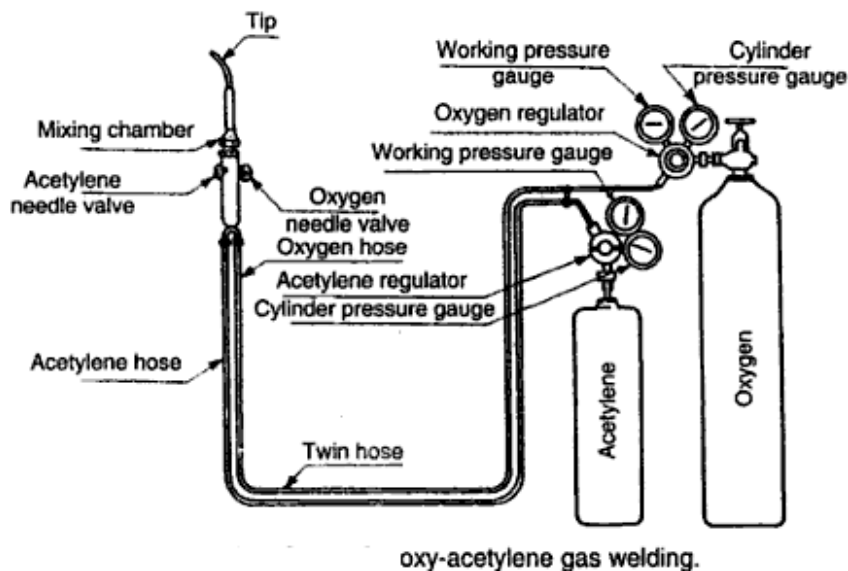
To join the given two work piece as per the required type of joint by gas welding

**Materials required:**

Two mild steel plates.

**Tools required:**

1. Oxygen and acetylene gas cylinders with pressure regulators
2. Gas welding torch
3. Filler rod
4. Gloves and apron
5. Safety goggles, gloves
6. Chipping hammer
7. Wire brush

**Procedure:**

1. Clean the given work piece thoroughly and remove rust, scale and other foreign materials.
2. Position the joining work pieces properly.
3. Open acetylene and oxygen cylinder valves and open the acetylene torch valve.
4. Light the tip of torch using the lighter.
5. Adjust oxygen and acetylene torch to get the required flame.
6. Hold the welding torch and filler rod along the line of weld and weld by maintaining 3 mm gap between plate and inner core of flame.

**Result:**

Thus the required welding is obtained by gas welding process.

**Outcome:**

Able to join the given two work piece as per the required type of joint by gas welding.

**Viva - voce**

(Expt. No. 10 to 15)

1. What is meant by welding?
2. Welding is used to join similar (or) dissimilar metals. Say True (or) False.
3. Name the two important welding process.
4. Name the three basic types of joints, common to arc welding and gas welding.
5. What is gas welding?
6. What is flux?
7. What is the significance of filler material?
8. What is arc welding?
9. What is an electrode?
10. What are the types of electrodes used in practice?
11. What are the types of welding?
12. What is the temperature obtained in gas and arc welding?
13. List the equipments needed to carry out welding operation.
14. Which type of welding (Gas / Arc) you prefer?
15. What are the necessary precautions you have to take while welding?
16. Why you should not see the flame during the welding operation?
17. What are the two gases used in gas welding?
18. What are the different types of joints, you make in the lab?
19. What is the difference between riveting and welding?
20. How do welding is different from machining?

**Expt. No. 15****STUDY OF FOUNDRY****Aim:**

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

**Introduction:**

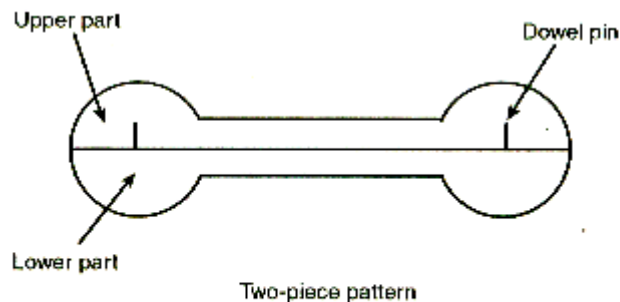
Foundry is a process of forming different shapes and sizes of metals in their molten state. It is also called as metal casting. The shape of the metal cast obtained depends on the shape and size of the cavity produced in sand mould by using a wooden model. This wooden model is called a pattern.

The foundry process involves three steps:

- Making the required pattern
- Moulding process to produce the cavity in sand using the pattern
- Pouring the molten metal into the cavity to get the casting

**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.



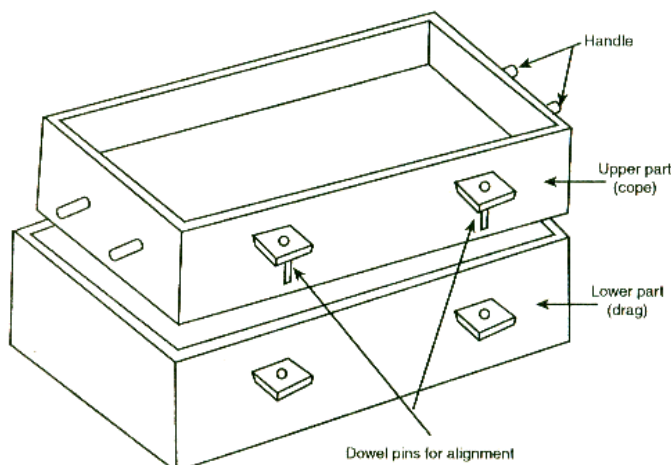
Two-piece pattern



Single-piece pattern  
(round pattern)

**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.

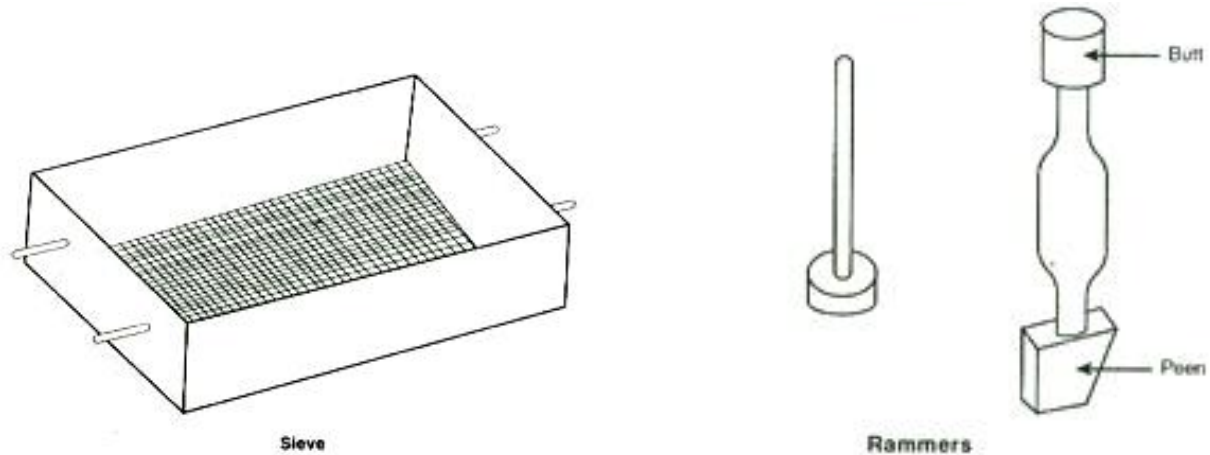


### Sieve:

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:

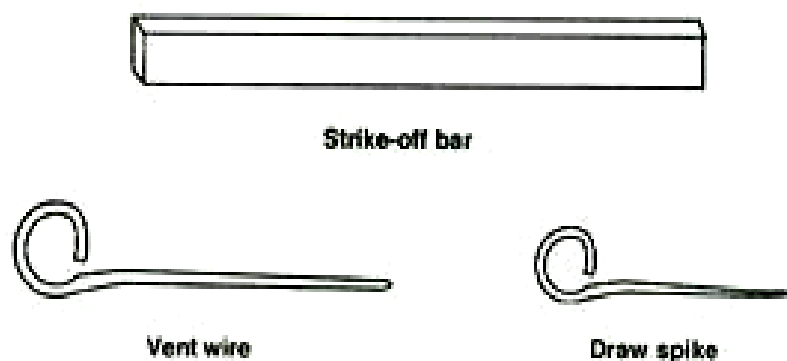
A strike off bar is a flat-edged rectangular bar made of wood. It is used to remove excess sand on top of the mould box after ramming.

### 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.

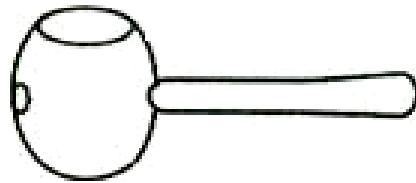


### Mallet:

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:**

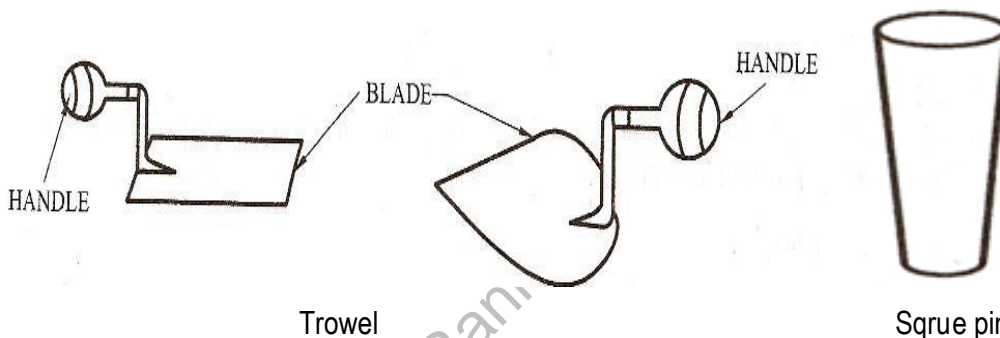
A lifter is used to remove the loose sand in the cavity produced in moulding. It is also used to finish the walls of the cavity after removing the pattern.

**Mallet****Lifter****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:**

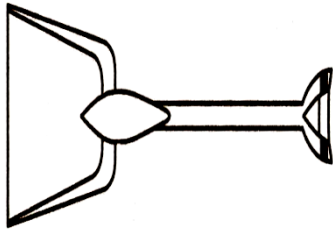
It is used to mix and move the mould sand from one place to another in the foundry shop. It consists of a broad iron pan fitted with a long wooden handle.

**Bellow:**

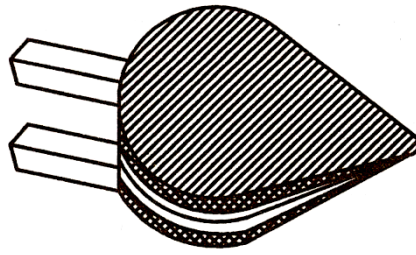
It is used to blow out sand particles and dust on the surface of the mould.

**Swab:**

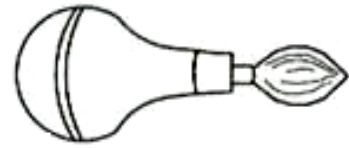
It is used to apply water on the edges of the pattern before removing it from the mould. It is easy to remove the moisturized pattern, otherwise mould sand sticks along with the pattern.



Shovel



Bellow



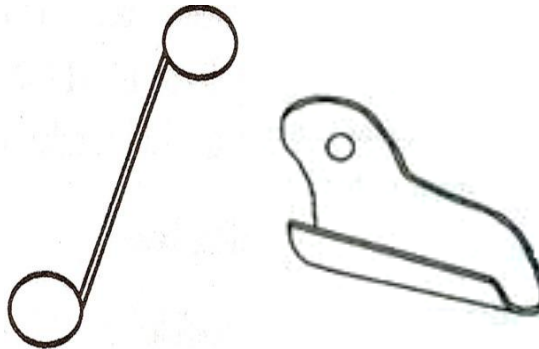
Swab

**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.



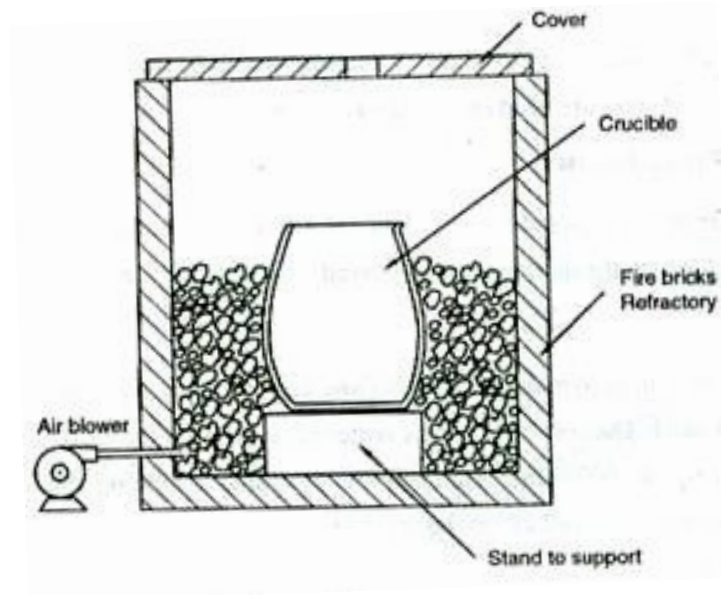
Slick

Gate cutter

**Melting furnaces:**

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

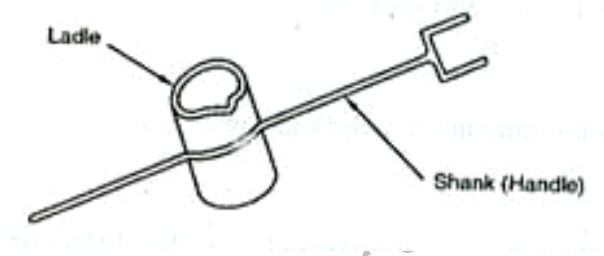
1. Coke fired crucible furnace
2. Oil fired crucible furnace
3. Gas fired crucible furnace
4. Cupola furnace
5. Electric furnace



Melting furnaces

### Shank Ladle:

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



Shank ladle

**Expt. No. 16****GEAR PATTERN**

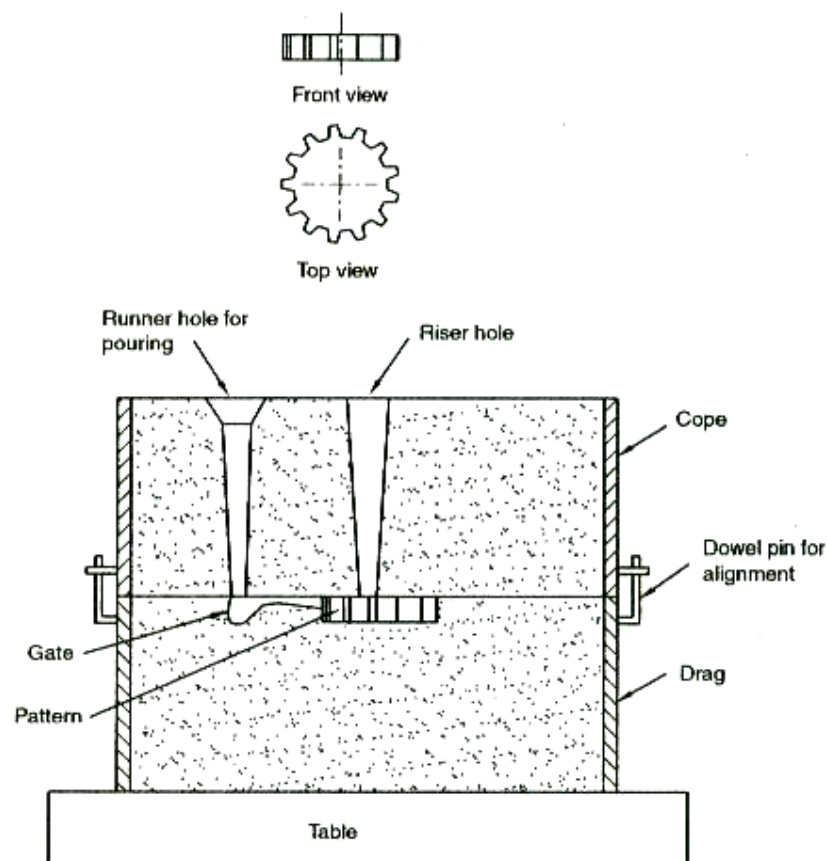
Aim:

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.

Gear pattern:





### 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.

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### Result:

Thus the mould of the given gear pattern is obtained.

### Outcome:

Able to prepare sand mould using a gear pattern.

**Expt. No. 17****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

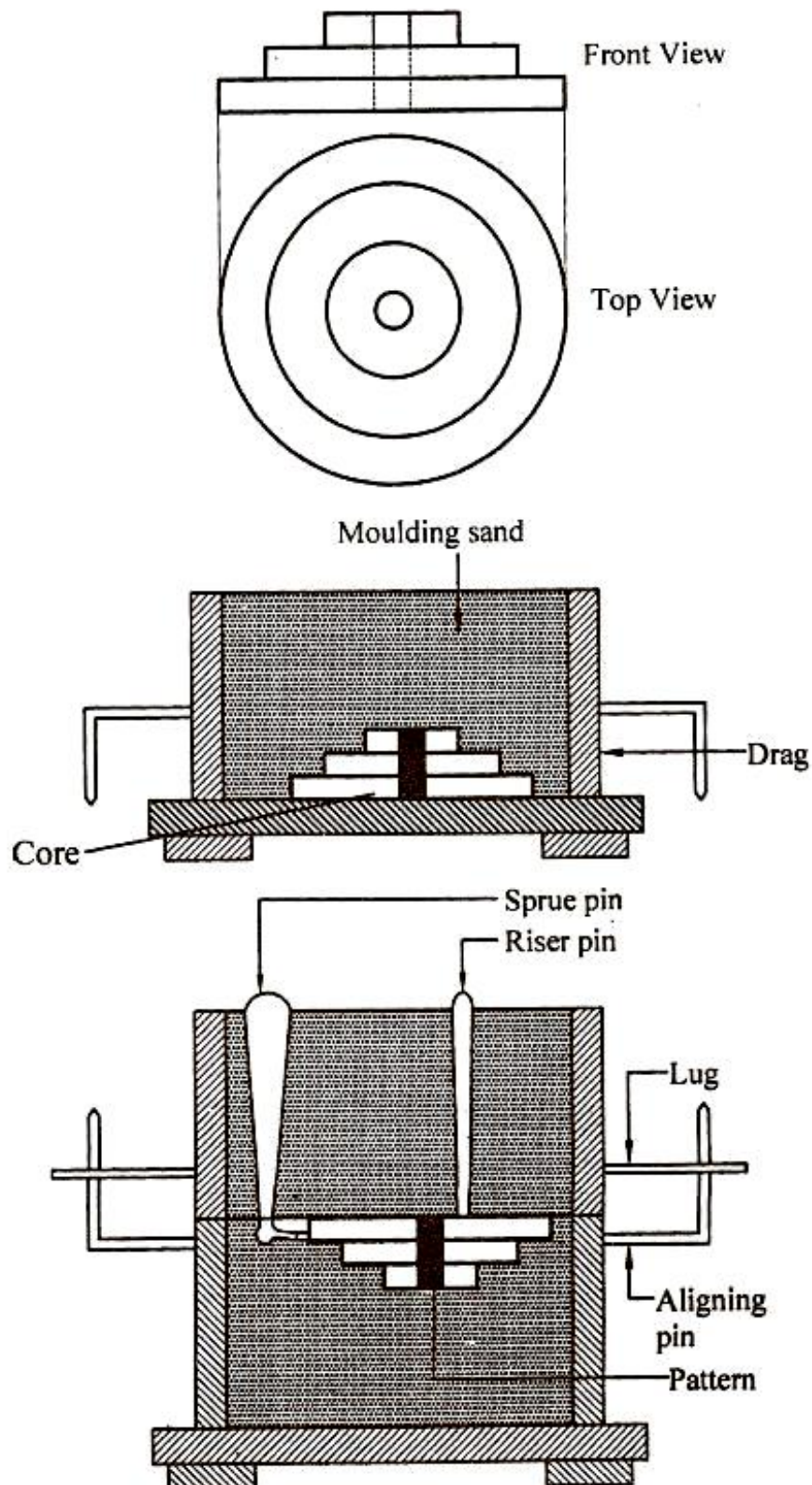
**Procedure:**

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 a 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.

Stepped cone pulley:



**Result:**

Thus the mould of the stepped cone pulley is obtained.

**Outcome:**

Able to make the mould for the given stepped cone pulley.

**Viva - voce**

(Expt. No. 29 to 31)

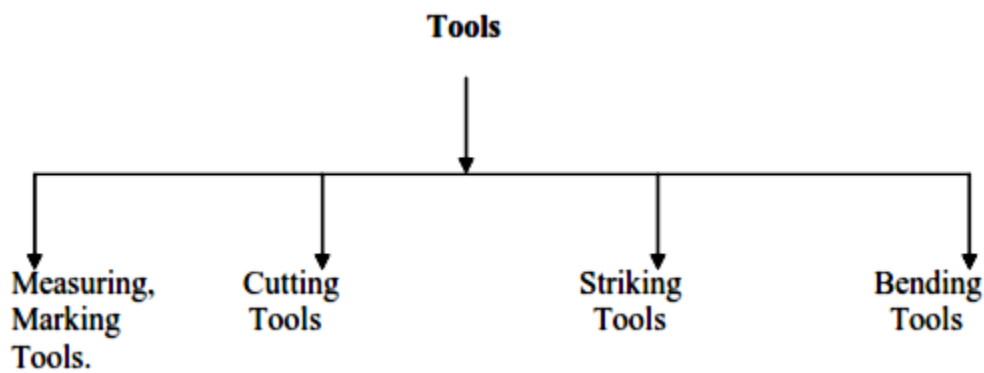
1. What is foundry?
2. What is meant by casting?
3. What is meant by pattern?
4. What are the materials used for making patterns?
5. Name the various types of pattern.
6. What are the types of allowances used for making pattern?
7. What is the name of the binder used to mix with moulding sand?
8. Name the different types of sand used in foundry work.
9. What are the ingredients of good moulding sand?
10. What are the types of casting used in foundry?
11. List the foundry tools?
12. What is gate?
13. What is vent rod?
14. Name the types of moulding boxes.
15. Give the application of casting.
16. What do you mean by green sand?
17. Why ramming is done?
18. What is the use of sprue pin?
19. What is the function of gate cutter?
20. What is the function of riser?

**Expt. No. 18****STUDY OF SHEET METAL WORK****Aim:**

To understand the basic concepts of sheet metal work by carrying out simple exercises relevant to its principles

**Introduction:**

Sheet metal is a process of working with sheets ranging from 8 gauge thickness to 30 gauge thickness. It is simple metal form into thin and flat pieces. It is by metal working, we can cut and bent metals variety of different shapes.

**Metals used for sheet metals works :**

The following are the most commonly used metals for sheet metal works.

**Black Iron:**

It is bluish black in colour. Since the metal is uncoated, it quickly gets corroded, to avoid this need to be coated i.e., painted or plated by metal. It is cheaper in cost.

**Stainless Steel:**

It is tougher than galvanized sheets, it is corrosion free in nature and need no coating over it. The stainless steel contain 18 percent Chromium, 8 percent nickel, 0.3 percent carbon. They are extensively used in manufacturing vessels which are more exposed to heat and moisture.

**Copper:**

It is extremely malleable and ductile material. Copper sheets are obtained cold working or hot working process. It doesn't need and protection coating over it. It is mainly used in making water pipes., wires mesh.

**Aluminium:**

It is white in colour and less in weight. It is high ductile malleable and corrosion free in nature. Aluminium are commonly used where heat is to be dissipate quickly. The components such as engine head, fins in pumps, aeroplane wings are manufactured using aluminium.

**Tin:**

It is the iron sheets coated with material tin. These materials are extensively used in roof works, food processing industries and in production of cans.

### Application of sheet metals :

Sheet metal works are widely used in car body manufacturing, aero plane, medicine tables cover, roof work in buildings.

### Tools used in sheet metal works:

#### Measuring and Marking Tools :

##### 1. Steel Rule:

It is a linear measuring tool. It is available in lengths of 150 mm and 300 mm of size, graduated both in mm and inches. Steel rules are usually made up of tempered rust free steel or stainless steel. The least count of steel rule is 1 mm

##### 2. Steel Tape:

It is used to measure larger length which could not be measured with a steel rule. It is made up of toughened spring steel strip. It gets wind up automatically when one edge is left. It is available in market at a standard length of 5 m and 10 m measured both in mm and inches.

##### 3. Swinging bevel protractor:

It is used for marking and to cut Lines at an angle on sheet metals.

##### 4. Divider:

Divider is used for dividing and marking the length Equally. It has both points sharpened like needle Points. The dividing length may be adjusted by a thumb screw provided on the divider.

##### 5. Tri square:

Tri square is used for marking and testing right angles. It consists of a steel blade riveted at right angle to the edge of the machined stock. The blade length varies from 150 mm to 300 mm.

##### 6. Scribes:

Scriber are hand tools used in the metal trades to mark lines on work pieces, prior to machining. This is instead of pencils as the marks from pencils cannot be seen as clearly as Scriber marks. It consist simply a rod of high carbon steel, in its hardened state, that has been sharpened to a point at one or both ends. They are used cut a mark over the surface of the work piece to leave a shallow scratch on its surface.

##### 7. Punch:

###### a. Prick punch:

This type of punch the cutting edge angle is around 30°. It helps making establishment points on sheets by supporting other tools such as dividers and trammel.

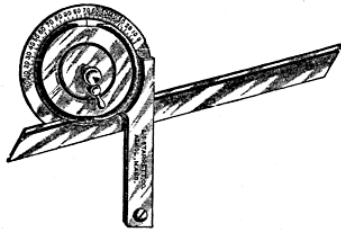
## Measuring and marking tools:



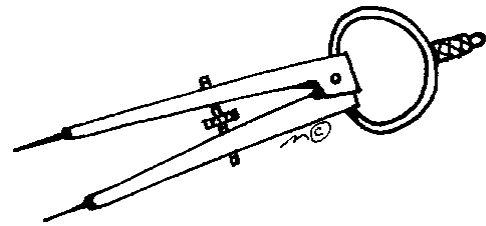
steel rule



steel tape



swinging bevel protractor



divider



tri square

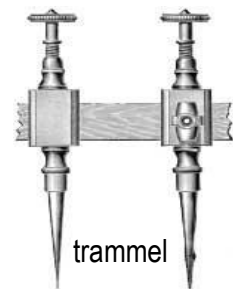


scribers

## PUNCHES



punches



trammel

## b. Stakes:

### 1. Solid punch:

Its edge is sharp as a needle. It helps to punch small holes on the metal sheets.

### 2. Hollow punch:

Hollow punch is wedge at an angle  $40^\circ$ . It helps to punch holes up to 10 mm diameter.



### 3. Trammel:

It is used for scribing circles and ellipses. A trammel is often used by metal workers and carpenters when marking out radii on a work piece from a blue print, an arc is too large to be drawn with compass.

## 8. Cutting Tools:

### 1. Chisel:

Cold chisels are used for cutting and shearing metals to tear and break. It is made up of high carbon steel or alloy steel. Flat chisel are tapered end with a sharp cutting edge which are hardened and tempered. The cutting edge is around  $40^{\circ}$  and  $45^{\circ}$ .

### 2. Snip:

Snip look similar to a pair of scissors but heavier than that. The snip are classified into straight snip and curved snip.

### 3. Straight snip:

Its cutting blades are straight in shape. It is used in metal sheets are required.

### 4. Curved snip:

Its blades are curved, so to make a circular cut in metal sheets. They are available in left hand cut and right hand cut.

## 9. Striking Tools:

### 1. Hammer:

Hammers are used in sheet metal works for shaping process like hollowing, raising, stretching, etc., The commonly used hammers for sheet metal works are ball pein hammer, riveting hammer, setting hammer, raising hammer and tray hammer.

### 2. Ball Peen hammer:

One side of the ball peen hammer is flat and the other side is spherical in shape. It is used for rounding-off rivets, making round and concave indentations and also for flattening the surfaces.

### 3. Riveting Hammer:

Its head is square face and a slightly curve shape with a bevel edge, its peen side double tapered and slightly round end. It is designed so to spread to riveted head during hammering.

### 4. Setting Hammer:

Its head is square with flat face and tapered pein with a beveled edge. The flat peen is used to flatten sheets without damages or marks.



## Bending Tools:

Pliers: Generally pliers are used in sheet metal for cutting, bending and holding the jobs from slipping. The various types of pliers commonly used as follows:

1. Flat Nose Pliers: It consist of a flat jaws with a small groove, The flat jaw is used for forming, holding the work piece.
2. Round Nose pliers: Its head is round and long, the outer surface of the nose is rounded. It is used for hold the various shapes of pattern in to work piece.
3. Stakes: Stakes are used as sheet metal anvil that supports the work while performing bending, seaming or forming process. The stakes are made of steel. Some of the most commonly used stakes are, Double seaming stake, candle mould stake, Hath stake, solid mandrel stake, bevel edge stake and hand dolly stake.

## Cutting tools:

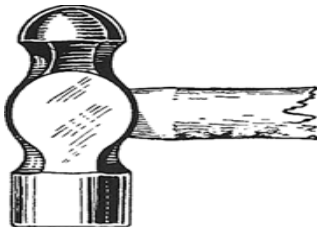


chisel

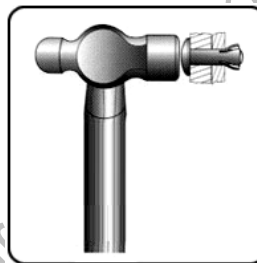


snip

## Striking tools:



hammer



riveting hammer

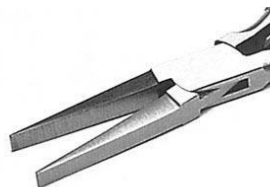


setting hammer

## Bending tools:



pliers



flat nose pliers



round nose pliers

## Sheet metal joints:

1. Hem: The sheet metal ends are strengthened by bending to  $180^{\circ}$  the sharp edges. There are three Types of hem:

- (a) Single Hem
- (b) Double Hem
- (c) Wired Hem

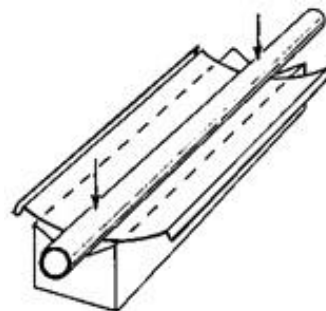
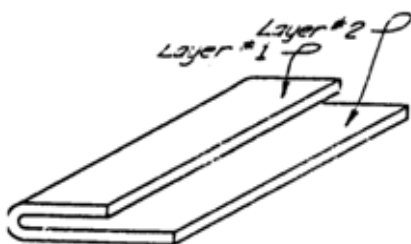
- a. Single Hem: It is the process of bending the sheet to  $180^{\circ}$  one time. This is done to make the edge stiffen.
- b. Double Hem: It is by bending the sheet and rolling twice. This is also done to stiffen the edges.
- c. Wired Hem: It is made by wrapping a piece of wire inside a sheet. It helps to strengthen the edge twice than other process.

2. Seam: Seam is a process of joining and fastening of two sheets together. The different types of seams are as follows:

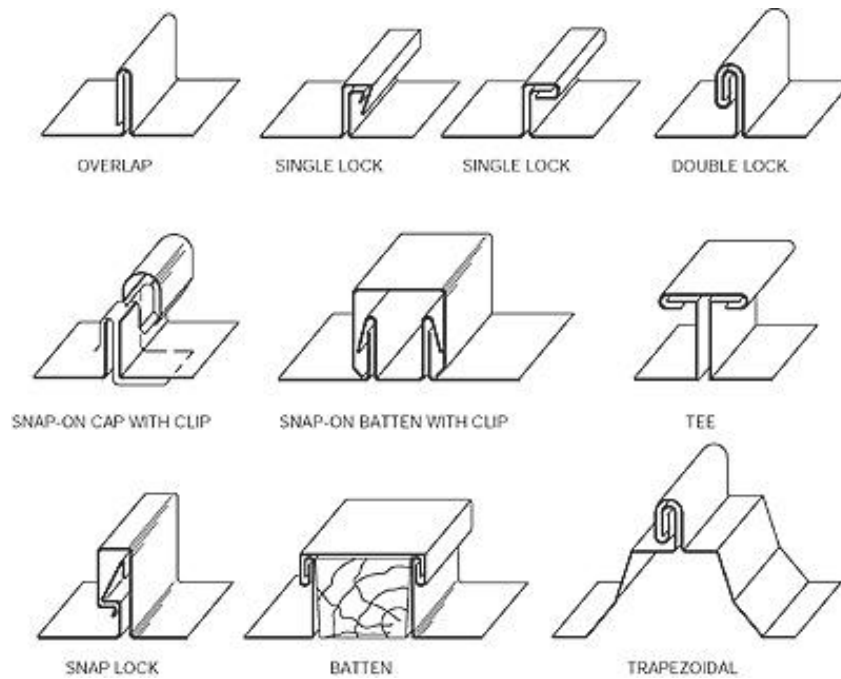
- (i) Lap seam
- (ii) Plain Seam
- (iii) Grooved Seam
- (iv) Single Seam
- (v) Double seam
- (vi) Standing seam

3. Riveting: Riveting is a process of joining Sheets permanently. The rivets are made up of soft iron and coated with thin to resist corrosion. The rivets are classified as per its head shape. Some of the rivets used often in sheet metal work are given in the figure.

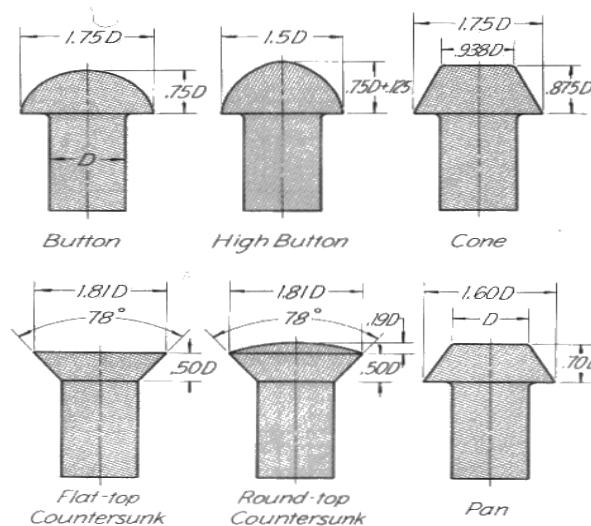
## SHEET METAL JOINTS



Hem



Seam



Riveting

## Sheet Metal forming operations :

(i) Blanking: It is an operation of cutting a flat shape from a sheet metal. The part punched out is called the blank and the remaining sheet is the scrap. In the blanking operation, the blank size is equal to the die size and the clearance is added to the punch.

(ii) Piercing: It is cutting operation by which various shaped holes are made in the sheet metal. In this operation, the hole in the required operation and the material punched out is the scrap. In the piercing operation the hole size is equal to the punch size and the clearance is added to the die.

(iii) Notching: This is the cutting operation by which pieces are cut from the edge of a sheet, strip or blank. The common notches are straight notch, square notch, V notch.

(iv) Trimming: This operation is done to remove the flash or unwanted excess material from the previously formed components. Special dies called trimming dies are used for this operation.

(v) Shaving: This operation is done to cut the edges of the blanked part accurately and in maintain close and accurate dimensions. The shaving operation removes the rough and uneven edges of the blanked part.

(vi) Perforating: This operation produces number holes evenly spaced in regular pattern on a sheet metal.

(vii) Bending: It is creation of a formed feature by angular displacement of a sheet metal work piece. In this operation, the material in the form of flat sheet or strip is uniformly strained around a linear axis which lies in the neutral plane and perpendicular to the lengthwise direction of the sheet or metal.

(xi) Curling: Curling is the operation of forming the edges of a component into roll or curl by bending the sheet metal in order to strengthen the edges and to provide smoothness to the surface.

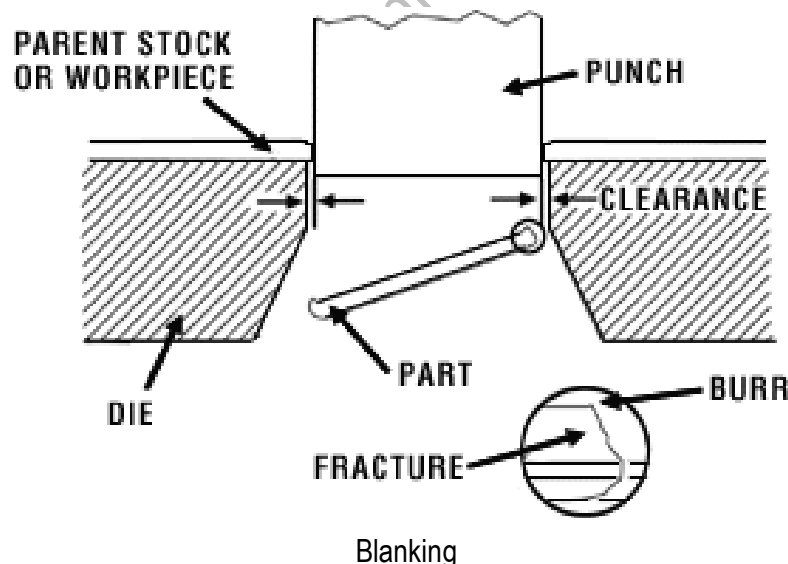
(x) Drawing: It is a process of forming a flat work piece into a hollow shape by means of a punch which causes the blank to flow into a die cavity.

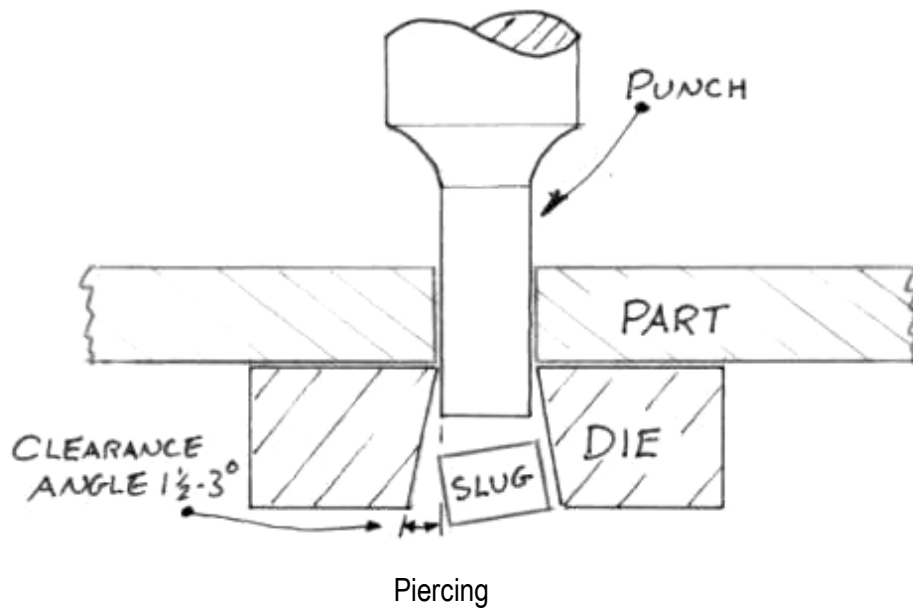
(xi) Lancing: Lancing is a combination of cutting and bending. It is the operation of cutting a sheet metal through part of its length and then bending the cut portion. There is no scrap in this operation.

(xii) Squeezing: In this operation, the metal is squeezed within the cavity of the die and the punch to attain the desired shape.

### Applications:

It is used for making hoppers, funnels, various ducts, chimneys, ventilating pipes, machine tool guards etc.,





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**Expt. No. 19****RECTANGULAR TRAY****Aim:**

To make a rectangular tray from the given sheet metal

**Material supplied:**

22 gauge Galvanized Iron (GI) sheet

**Tools required:**

1. Steel rule
2. Mallet
3. Scriber
4. Divider
5. Protractor
6. Snips
7. Stakes
8. Rivet set
9. Ball pein hammer

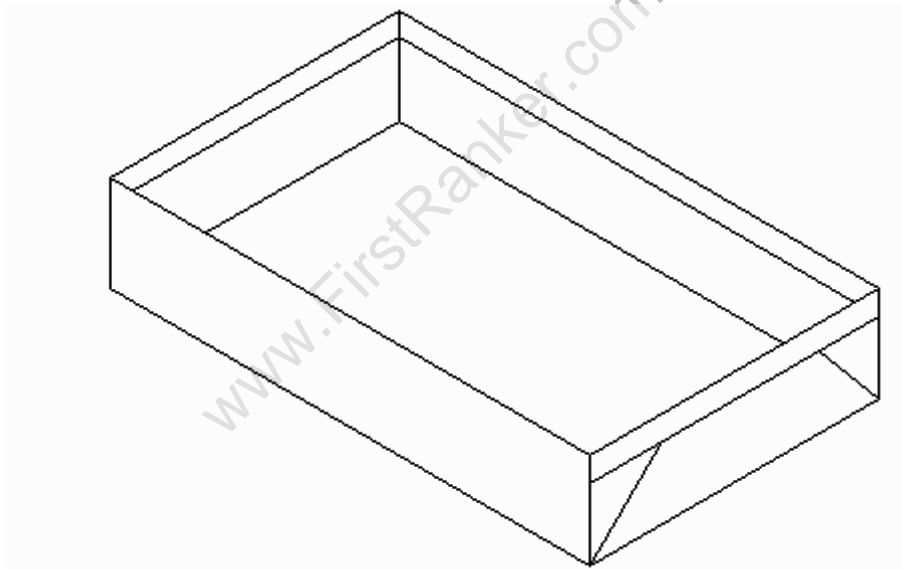
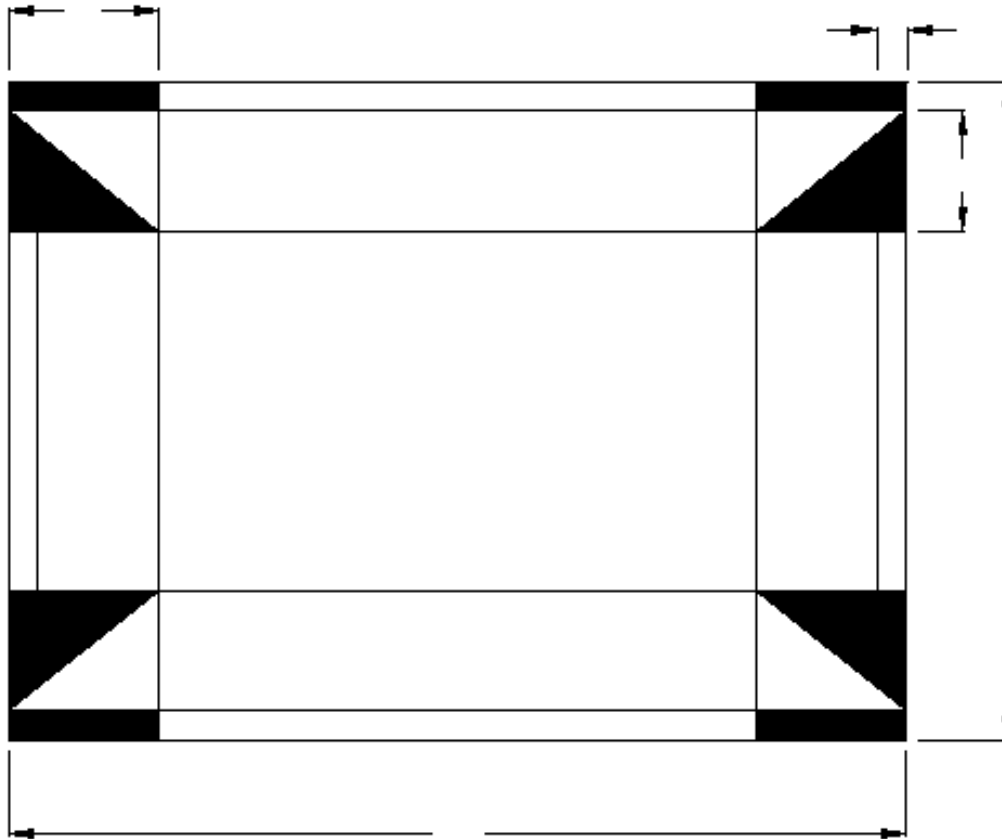
**Sequence of operation:**

1. Checking
2. Levelling
3. Marking
4. Cutting
5. Bending
6. Hemming
7. Riveting

**Procedure:**

1. Check the size of the given sheet for its dimensions using a steel rule.
2. Level the sheet on the levelling plate using a mallet.
3. Follow the development procedure same as square taper tray.
4. Mark the dimensions.
5. Mark a single hemming on the four sides of the tray.
6. Bend this four sides of the tray to  $90^{\circ}$  using stakes anvil.
7. Finally join all the corners of the tray by riveting.

Development of rectangular tray:



**Result:**

Thus the desired rectangular tray is made from the given sheet metal.

**Outcome:**

Able to make a rectangular tray from the given sheet metal.

**Expt. No. 20****CYLINDER****Aim:**

To make a cylinder from the given sheet metal

**Material supplied:**

22 gauge Galvanized Iron (GI) sheet

**Tools required:**

1. Steel rule
2. Mallet
3. Scriber
4. Divider
5. Protractor
6. Snips
7. Stakes
8. Groover solder

**Sequence of operations:**

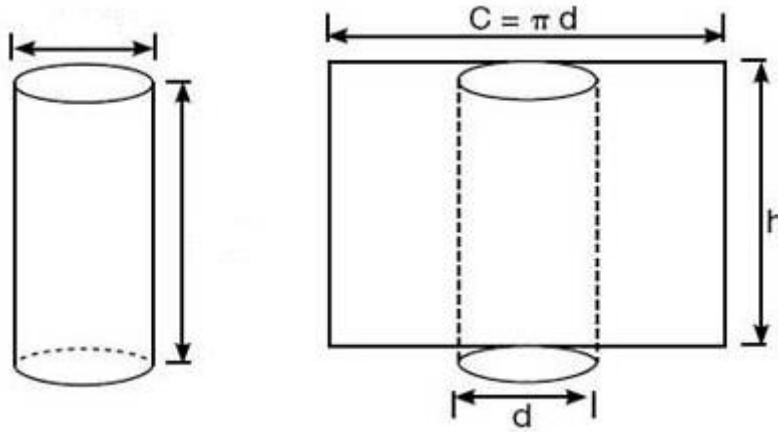
1. Checking
2. Levelling
3. Marking
4. Cutting
5. Folding
6. Seaming
7. Soldering

**Procedure:**

1. Check the given sheet metal for its dimensions using steel rule.
2. Level the sheet on the levelling plate using a mallet.
3. Choose suitable dimensions for the sides where the dimensions are not given, and mark out development of sheet by the parallel line development as per dimensions.
4. Remove the unwanted material using straight snips.
5. fold in such a way to get the cylinder shape.
6. Join both the closing edges together by seaming process.
7. Finally, close the bottom of the cylinder with round portion of the sheet metal and solder on the outer periphery of the round portion with the cylinder.



Development of Cylinder:



Result:

Thus the cylindrical container is made from the given sheet metal.

Outcome:

Able to make a cylinder from the given sheet metal.

**Expt. No. 21****FUNNEL****Aim:**

To make a funnel from the given sheet metal

**Material supplied:**

22 gauge Galvanized Iron (GI) sheet

**Tools required:**

1. Steel rule
2. mallet
3. Ball pein hammer
4. scribe
5. white paper
6. straight snips
7. groover
8. solder

**Sequence of operation:**

1. Checking
2. Leveling
3. Marking on paper
4. Marking on sheet metal
5. Cutting
6. Folding
7. Hemming
8. Soldering

**Formula used:**

$$\text{Angle } \phi = (R/L) \times 360^\circ$$

Where, R = radius of the top circle of the funnel

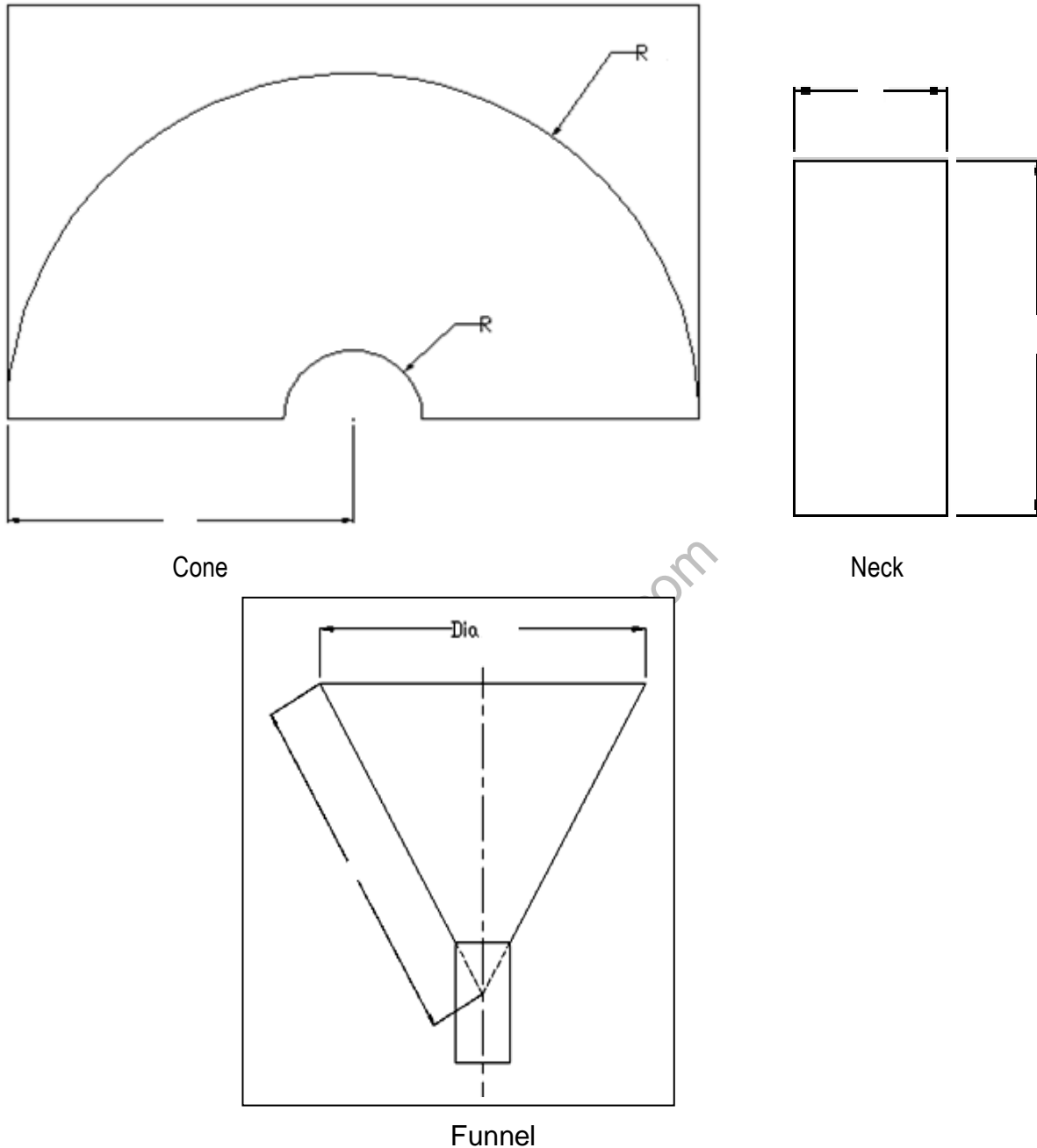
L = Slanting length

**Procedure:**

1. Check the size of the given sheet metal is checked for its dimensions using steel rule.
2. Mark the required development of surface on the white paper which is over lapped on the sheet metal.
3. Mark on the sheet metal as per the development being done on the paper.
4. Now using straight snips, remove unwanted materials.

5. Now fold and bend the work piece to make the funnel shape and joint is made on the work pieces
6. Then using groover, make locked grooved joint for about 5 mm. Also, do hemming in the bottom of the funnel.
7. In between top face and bottom face, make butt joint using solder.
8. Finally, carrying out trimming and finishing operation.

Development of funnel:



Result:

Thus the funnel of the required dimensions is made from the given sheet metal.

Outcome:

Able to make a funnel from the given sheet metal.

Viva - voce

(Expt. No. 18 to 21)

1. Define - Sheet Metal
2. What is the application of sheet metal?
3. What are the metals used for sheet metal work?
4. Name the various types of tool used for sheet metal?
5. Explain the different types of operations in sheet metal?
6. What are the methods are used in sheet metal?
7. What is the formula used to make a cone from sheet metal?
8. What is the sequence of operations?
9. What is the use of snips?
10. What is bending?
11. What is the tool is used to measure the thickness of sheet metal?
12. What do you mean by gauge?
13. What is the application of sheet metal?
14. What is punching?
15. Why anvil is needed?
16. What is hem? What is seam?
17. What is the use of rivet set?
18. What is stake? List the different types of stakes?
19. List the different types of cutting tools used in sheet metal?
20. List the various marking tools used in sheet metal?

**Expt. No.22****KNURLING AND GROOVING****Aim:**

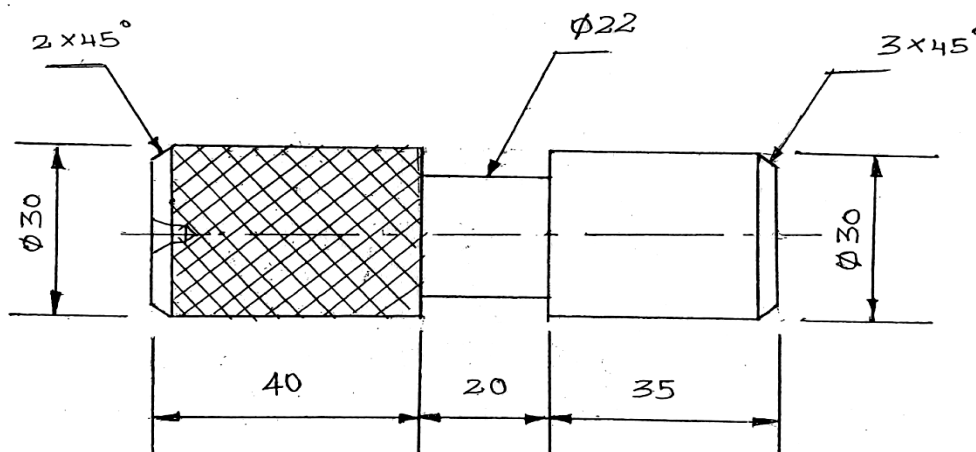
To produce the component by performing knurling and grooving operation using lathe

**Material required:**

Mild steel rod size of dia. 32 mm and length 100 mm

**Tools required:**

1. Single point cutting tool
2. Knurling tool
3. Pitch gauge
4. Grooving tool
5. Drill chuck with centre drill bit

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Check the size of raw material given and ensure the size.
2. Held the work pieces in the chuck and tight it properly.
3. Clamp the tool on tool post properly and check the centre of work piece with cutting tool tip.
4. Do the facing operation by giving cross feed to the cross slide and reduce the length.
5. Do the turning operation by giving longitudinal feed to the carriage and reduce the length.
6. Two or three passes can be given for the turning operation.
7. The grooving tool is fixed in the tool holder on lathe.

8. The work piece is fixed in the machine vice. Then switch on the machine.
9. Make the grooving operation as per the dimension using grooving tool.
10. Then place a knurling tool in the tool holder of lathe.
11. Make the knurling operation as per the dimension using knurling tool.
12. Make the chamfer at the end of the component.
13. Remove the component and inspect its size.

### Result:

Thus the component is produced by performing knurling and grooving operation using lathe.

### Outcome:

Able to produce the component by performing knurling and grooving operation using lathe

Viva - voce
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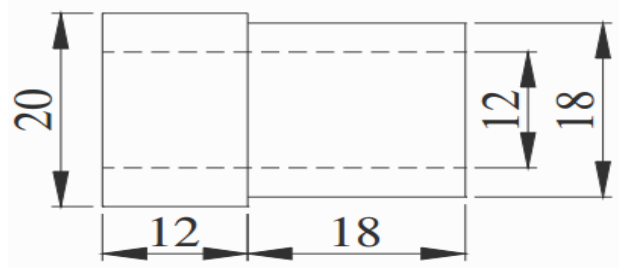
1. What is the purpose of knurling?
2. What are the various types of knurling tool?
3. Which machine used for knurling operation?
4. What is meant by Machinability index?
5. What is the purpose of grooving?
6. What are various types of grooving tool?
7. Write the Taylor's tool life equation.
8. What are the purposes of gear grinding process?
9. What is meant by gear lapping?
10. What is meant by cutting shaping process?
11. Define – Tool life
12. What are the factors affecting tool life?
13. What are the factors affecting the machinability?
14. Define – Machinability of metal
15. What are the purposes of chip breakers?

**Expt. No.23****CAPSTAN LATHE****Aim:**

To machine the work piece to the given dimensions using capstan lathe

**Tools and equipments required:**

Capstan Lathe, stopper, drill chuck, counter sink bit, drill bit, turning tool, parting off tool, Verneir Caliper.

**Specimen drawing:**

All dimensions are in mm

**Procedure:**

1. Prepare the tooling layout for the given workpiece.
2. Set the tools in their respective positions of the tool stations.
3. The workpiece is chucked and checked for the rotation.
4. The adjustment to the length of feed for each tool is adjusted by rotating the adjustment screws.
5. Feed the tools in the required sequence to machine the given workpiece.

**Result:**

Thus the given workpiece is machined to the given dimensions using capstan lathe.

**Outcome:**

Able to machine the work piece to the given dimensions using capstan lathe

1. What is meant by drilling?
2. What is meant by gang -drilling machine?
3. What are the specifications of drilling machine?
4. What are the machining operations that can be performed on a drilling machine?
5. What are the different ways to mount the drilling tool?
6. What is meant by broaching?
7. What are the specifications of a broaching machine?
8. What are the advantages and limitation of broaching?
9. What are the different operations that can be performed on a broaching machine?
10. What is meant by boring?
11. Differentiate between drilling and boring
12. What is meant by counter boring?
13. What is meant by counter sinking?
14. Which type of tool used for boring?
15. What is meant by pitch circle diameter?

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