GE6162 ENGINEERING PRACTICES LABORATORY MANUAL – REGULATION 2013 As per Anna University Syllabus Common to all branches

CIVIL ENGINEERING PRACTICE

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PREFACE

Laboratory work is a prominent feature of education in Science and Technology based subjects. However, it should not be forgotten that practise without theory is blind and Theory without practise is lame. A person interested in acquiring engineering skills must have a balanced knowledge of theory as well as practise. Thus, engineering practice, a study and practice of the scientific principles underlying the art of manufacture.

This manual is prepared in accordance with the latest syllabus of Anna University for Engineering Practise - Civil laboratory.

WORKSHOP SAFETY PRECAUTIONS

WORKSHOP :

It is a place where the man, the machine and the tool works together for manufacturing a product. It is the place where the raw material is converted into a new product.

GENERAL INSTRUCTIONS:

1. Always prefer to use leather shoes.
2. Never use loose clothes.
3. Full sleeve shirts should be avoided.
4. Never use neck tie while working.
5. Never mix the Measuring tools with cutting tools.
6. Keep the surroundings clean.
7. Every tool should have a proper place and it should be kept at its proper place after use.
8. Always wear lab coats.

SYLLABUS

GE6162 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

CIVIL ENGINEERING PRACTICE 9

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings - Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

CARPENTRY

CARPENTRY

INTRODUCTION

Carpentry may be defined as the process of making wooden articles and components such as doors, windows, Furniture etc. Carpentry involves cutting, shaping and fastening wood and other materials together to produce a finished product. Preparation of joints is one of the important operations in wood work.

Joinery denotes connecting the wooden parts using different points such as lap joints, mortise and tenan joints, bridle joints, etc.

TIMBER

Timber is the material used for carpentry. It is the name given to the wood obtained from well grown trees called exogenous trees. Timber is made suitable for engineering purposes by sawing into various sizes.

ADVANTAGES OF TIMBER

- It is easily available
- It is lighter and stronger to use
- It responds well for polishing and painting
- Suitable for sound proof construction
- It is easy to work with tools
- It is very economic

Classification of Timber

1. SOFT WOOD
    - It is obtained from trees having long needle shaped leaves
    - It is light in weight
    - It is easy to work
    - It is relatively less durable
    - It has good tensile resistance and poor shear resistance
    - It has straight fibers and fine texture
    - It is widely used for construction
2. HARD WOOD
    - It is obtained from trees having broad leaves
    - It is heavier in weight and dark in colour
    - It is difficult to work
    - It is highly durable
    - Its fibres are quiet close and compact
    - It has both tensile and shear resistance
    - It widely used for doors, windows and furnitures

STUDY OF CARPENTRY TOOLS

Carpentry tools are used to produce components to an exact size. The types of carpentry tools are as follows.

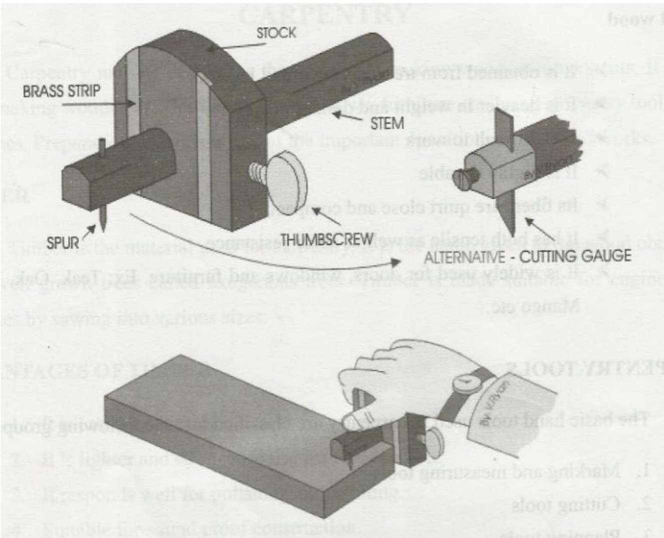
1. Marking tools	2.Measuring tools	3. Holding tools
4. Cutting tools	5.Planning tools	6.Boring tools
7. Striking tools	8.Miscellaneous tools	

MARKING TOOLS

Accurate marking is important in carpentry to produce components to exact size.

1. Marking gauge

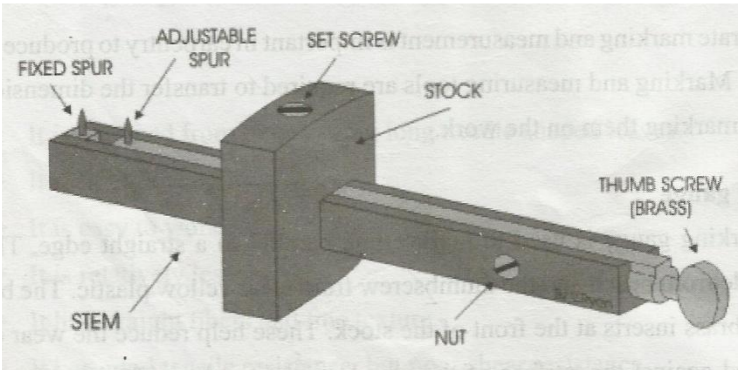
It consists of a square wooden stem with a sliding wooden stock on it. On the stem, a marking pin is attached which is made up of steel. This stem is provided with a steel nail to scratch the surface of the work.



Marking gauge

2. Mortise gauge

It consists of two pins; the distance between the pins is adjustable. It is used to draw parallel lines on the stock.



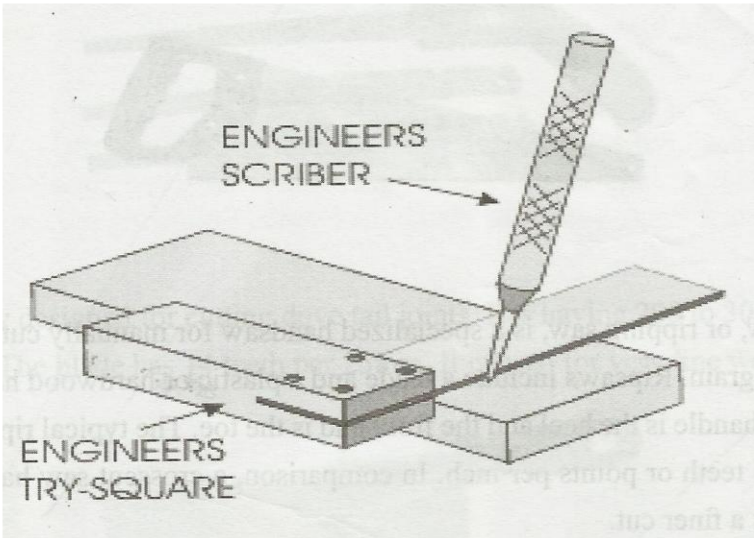
Mortise gauge

3. Try Square

The engineer's try-square is composed of two parts, the stock and the blade. They are usually made from mild steel with blade being hardened and tempered to resist damage. The try square is pushed against a straight side of the material. An engineer's scriber is then used to scratch a line onto the surface of the material.

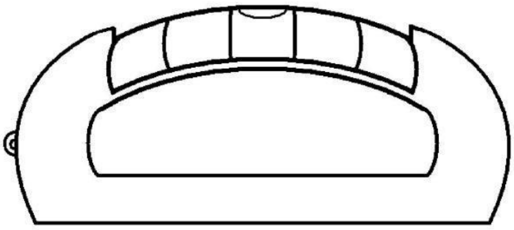
4. Scriber

A Scriber is a hand tool used to mark lines on workpieces. This is used instead of pencil. They consist simply of a rod of high carbon steel with a sharpened point.



5. Spirit level

Spirit levels are used for testing the position of large surfaces. It is used for testing horizontal position of the workpieces. It is having a glass tube with air bubble.



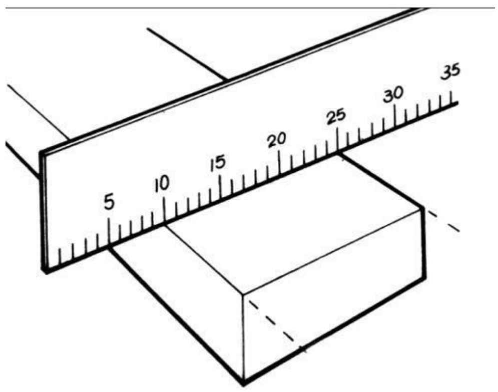
Spirit level

MEASURING TOOLS

The carpentry measuring tools are used to measure the dimensions in the wood for exact measurement in cutting.

1. Carpenter's steel rule

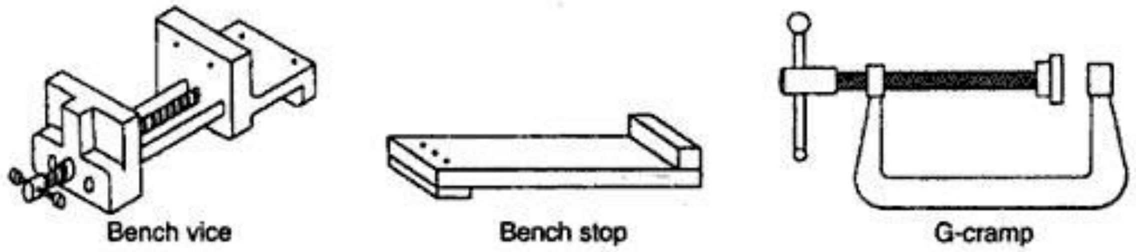
Large measurements can be made by steel rule. It is also suitable for measuring circumference of curved surfaces.



Steel Ruler

HOLDING TOOLS

The carpentry holding tools are shown in figure



Holding tools.

1. Carpentry vice or Bench vice

A carpentry vice is the common work holding device. It consists of one fixed jaw and one movable jaw. It's one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle.

2. Bench stop

It is a simple straight flat plank of wood having two projected rectangular sections of wood screwed on opposite side of the plank. The work is placed in such a way that it is always butting against the projected portion so as to resist the work from moving.

3. G-clamp

G-clamp is made up of malleable iron with acme threads of high quality steel .It can be used for clamping small work when gluing up.

CUTTING TOOLS

1. Saws

A saw is used to cut wood into pieces. There is different type of saws, designed to suit different purpose. A saw is specified by the length of its tooled edge. The following saws are used in the carpentry section.

Rip Saw

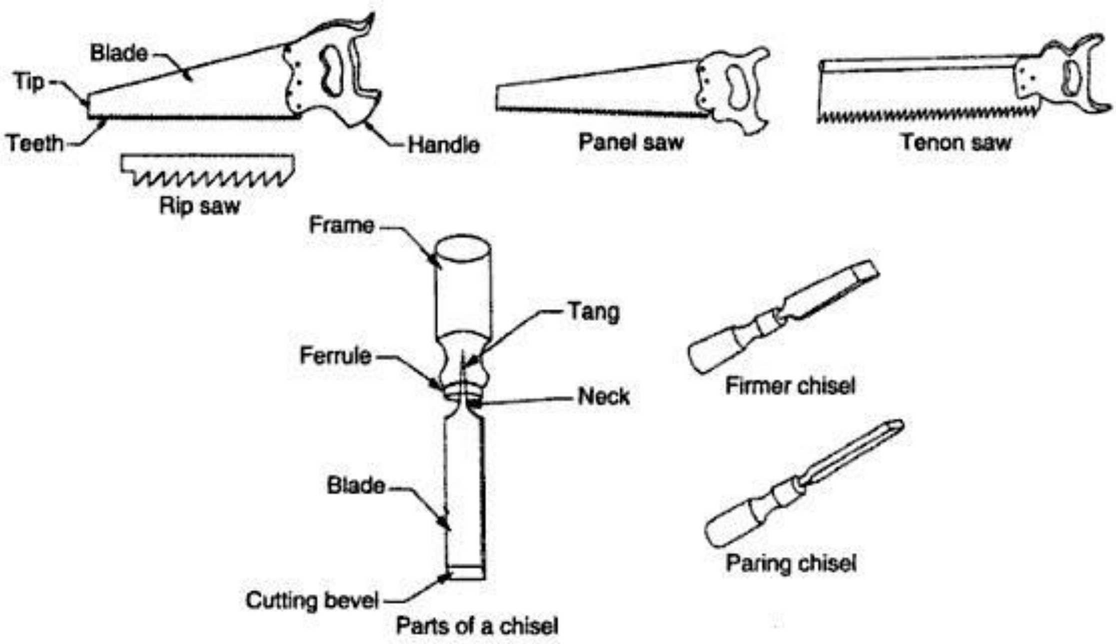
The blade of rip saw is either straight or skew-backed. The teeth are so set that the cutting edge of this saw makes a steeper angle about 60^0

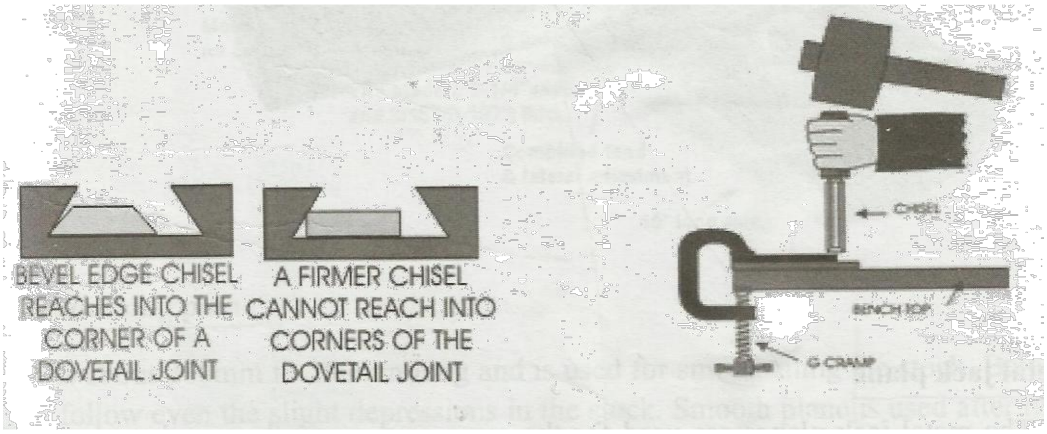
Cross Cut saw

This is similar in shape of a rip saw. It is used to cut across the grain of the stock. The correct angle for cross cutting is 45^0.The teeth are so set that the saw kerfs is wider than the blade thickness. This allows the blade to move freely in the cut without sticking.

Tenon or back saw

A tenon saw is used for fine and accurate work. It consists of a very fine blade, which is reinforced with a rigid steel back. The teeth are shaped like those of cross cut saw.





2. Chisels

Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50mm. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle.

Firmer chisels

These are general purpose chisels and are used either by hand pressure or by a mallet. The blade of a firmer chisel is flat and their sloping face is at an angle 15^0 to 52^0.

Mortise Chisels

These are general purpose chisels and are used for cutting mortises above 9mm wide. The blade of a firmer type is in which they have a thicker section and a stronger neck. By means of this chisel we can apply more Leverage to remove waste wood from the mortise.

Bevel chisels or Dove tail chisel

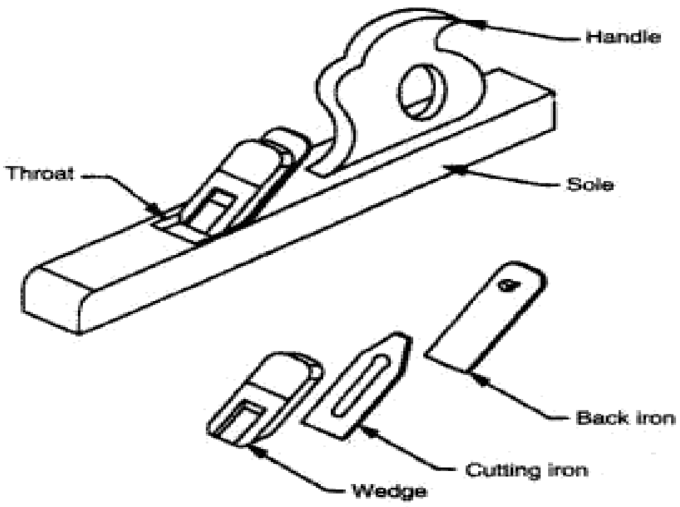
A bevel chisel is similar in construction to the firmer chisel. Its edges are bevelled to allow access to difficult corners. It has a blade with a bevelled back due to which it can enter sharp corners for finishing in dove tail joints.

PLANNING TOOLS

In general, planes are used to produce flat surfaces on wood. The cutting blade used in a place is very similar to a chisel. The blade of a plane is fitted in a wood or metallic block at an angle.

1. Jack plane

Jack plane which is about 35 cm long is used for general planning. A Jack plane that is about 20 to 25cm long is used for smoothening the stock. It can follow even the slight depressions in the stock better than the jack plane. Smooth plane is used after using the jack plane.



Planing tools.

Jack plane

2. Rebate plane

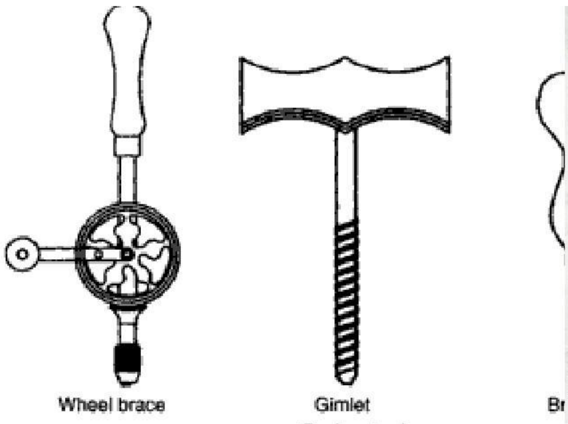
A rebate plane is used for making a rebate. A rebate is a recess along the edge of a piece of wood which to generally used for positioning glass in frames and doors. A plough plane is used to cut grooves, which are used to fix handle in a door.

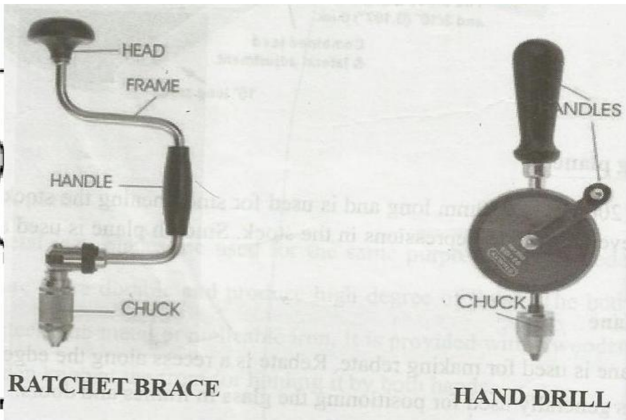
BORING TOOLS

Boring tools are used to make holes in wood. Common types of boring tools are as follows.

1. Gimlet

It has cutting edges like a twist drill. It is used for boring holes with the hand pressure.





2. Hand drill

A straight shank drill is used with this tool. It is small, light in weight and may be conveniently used. The drill bit is clamped in the end.

3. Ratchet brace

It consists of crank made of steel, wooden handle in the middle, head at the top and chuck at the bottom. The bit rotates when the crank is rotated by hand.

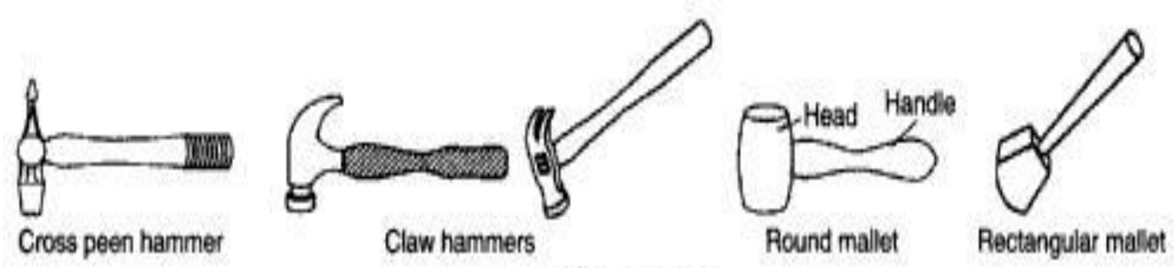
STRIKING TOOLS

1. Hammers

The cross peen hammer is mostly used for positioning small nails. The head is tightly held in the handle with the help of iron wedges. The claw hammer is effective in removing very large nails and also for driving the nails using the other end of the hammer.

2. Mallet

A mallet is used to drive the chisel, when considerable force is to be applied, which may be the case in making deep rough cuts. A steel hammer should not be used for this purpose, as it may damage the chisel.



Striking tools.

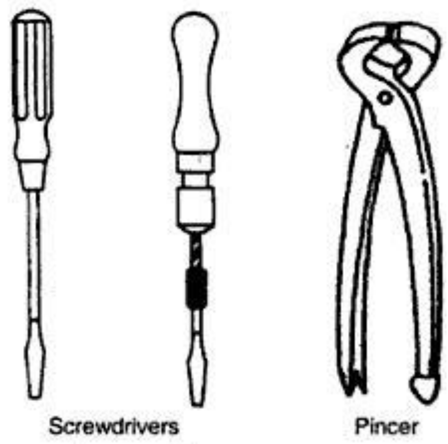
MISCELLANEOUS TOOLS

1. Pincers

They are made up of steel with a hinged joint and are used for pulling out small nails from wood.

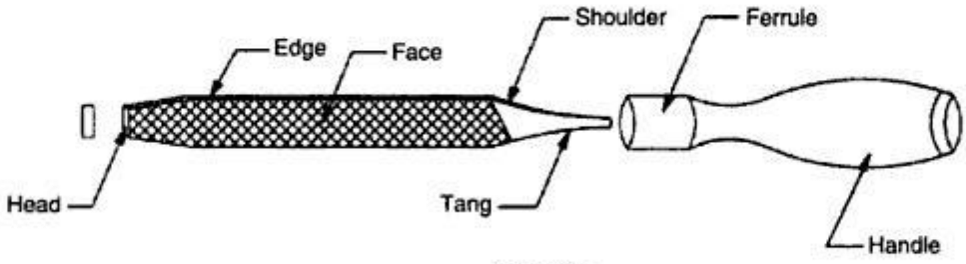
2. Screwdrivers

Screwdriver is used for driving wood screws into wood or unscrewing them. The screwdriver used in carpentry is different from the other common types.



3. Rasp file

A rasp file is a file used for finishing the surface of wood. The rasp has sharp cutting teeth on its surface for this purpose. The file is used for removing rasp marks end finally the scratches left by the fix are removed with the scraper and glass paper.



Rasp file.

4. Oil stone

This is an essential flat used for providing sharp edges on cutting tools. The oil stones may be artificial or natural stones. The carborundum is the best artificial stones where as the Arkansas are the natural stones.

CARPENTRY PROCESSES

In a carpentry shop, a number of operations are performed to get the finished workpiece. The different types of process performed in a carpentry shop can be classified as follows.

1. Marking and Measuring

It is the process of setting of dimensions on wooden pieces to obtain the required shape. This is the first step for further carpentry operations. The marking operation is done with use of marking tools. Before marking, one end is planed for reference.

2. Sawing

Sawing is the process of cutting wood to the required shape and size such as straight, inclined or curved. Sawing can be done along the grains or across the grains. In sawing, wooden work is fixed in a vice and wood is moved up to prevent vibrations during sawing.

3. Planning

Planning is an operation of obtaining, smooth, dimensionally true surface of wood by using a planer. It is done along the grains. So, smooth surface is achieved. This process can be also called facing or edging.

4. Chiseling

It is the process of cutting a small stock of wood to produce required shapes.

5. Mortising and Tenoning

Mortising is the process of producing a mortise, i.e. a rectangular or square holes and recesses in wooden pieces. A tenon is a projected piece of wood that fits into the corresponding mortise. This process is done by using mortise chisels and a mallet.

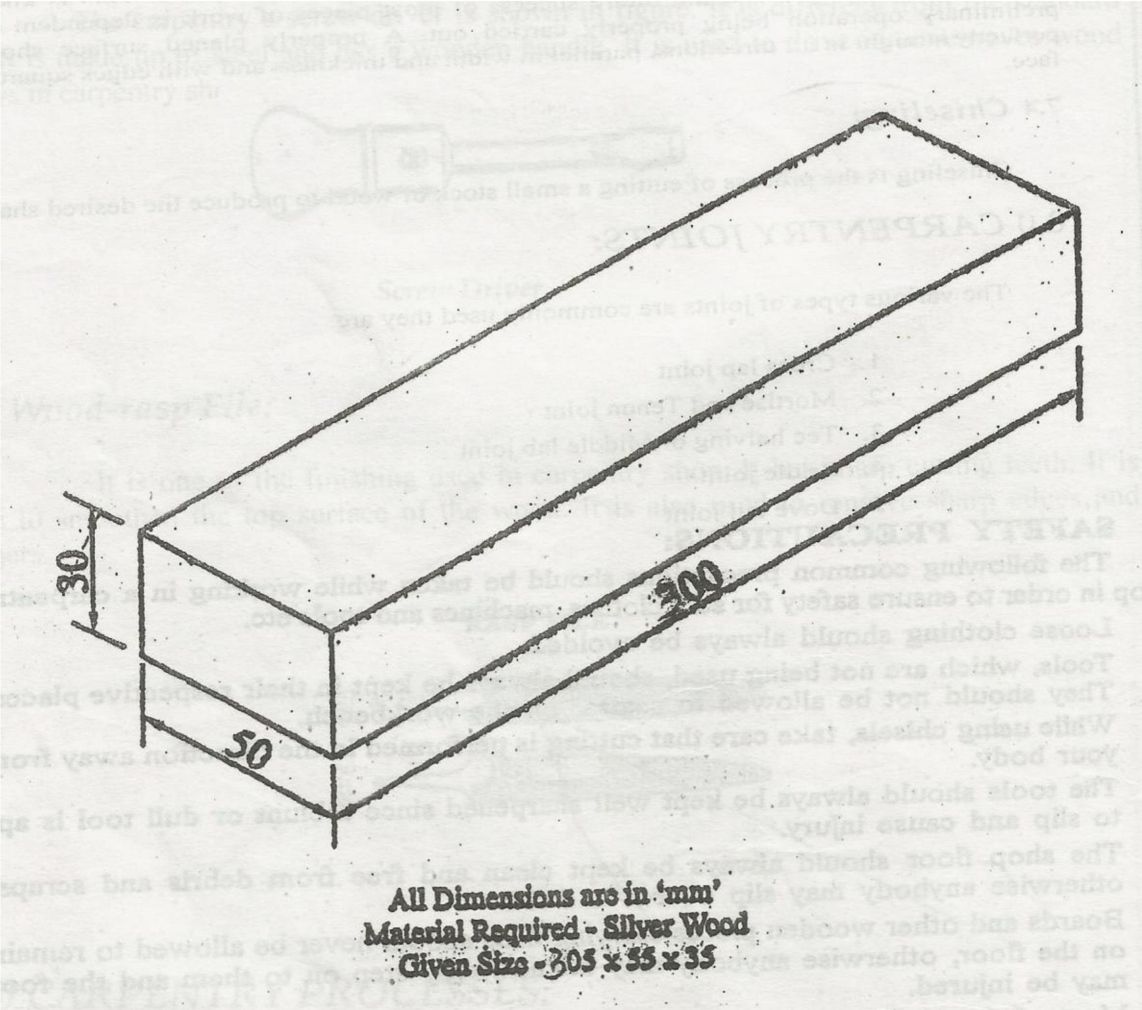
6. Boring

Boring is the process of producing through holes or blind holes in wooden piece. This process can be done straight or inclined according to the type of work. The small holes are produced by using bradawl and gimlet, whereas large holes are produced by using braces, drills.

7. Grooving

Grooving is the process of making grooves tonguing is the process of producing corresponding projections of wood for fitting into grooves. Grooving and tonguing operation can be seen in drawing boards, floor boards and partitions. Grooving is done with a plough plane tool, and tonguing is done with a moulding plane tool.

PLANING


30
50
300
All Dimensions are in 'mm'
Material Required - Silver Wood
Given Size - 305 x 55 x 35

Ex.No: **PLANING** Date:

Aim

To plane the given workpiece for the required shape.

Material Required

Soft wood of size 305x55x55 mm.

Tools Required

1. Jackplane
2. Bench vice
3. Try square
4. Marking gauge
5. Steel rule
6. Tenon saw
7. Rip saw
8. Firmer chisel
9. Mallet

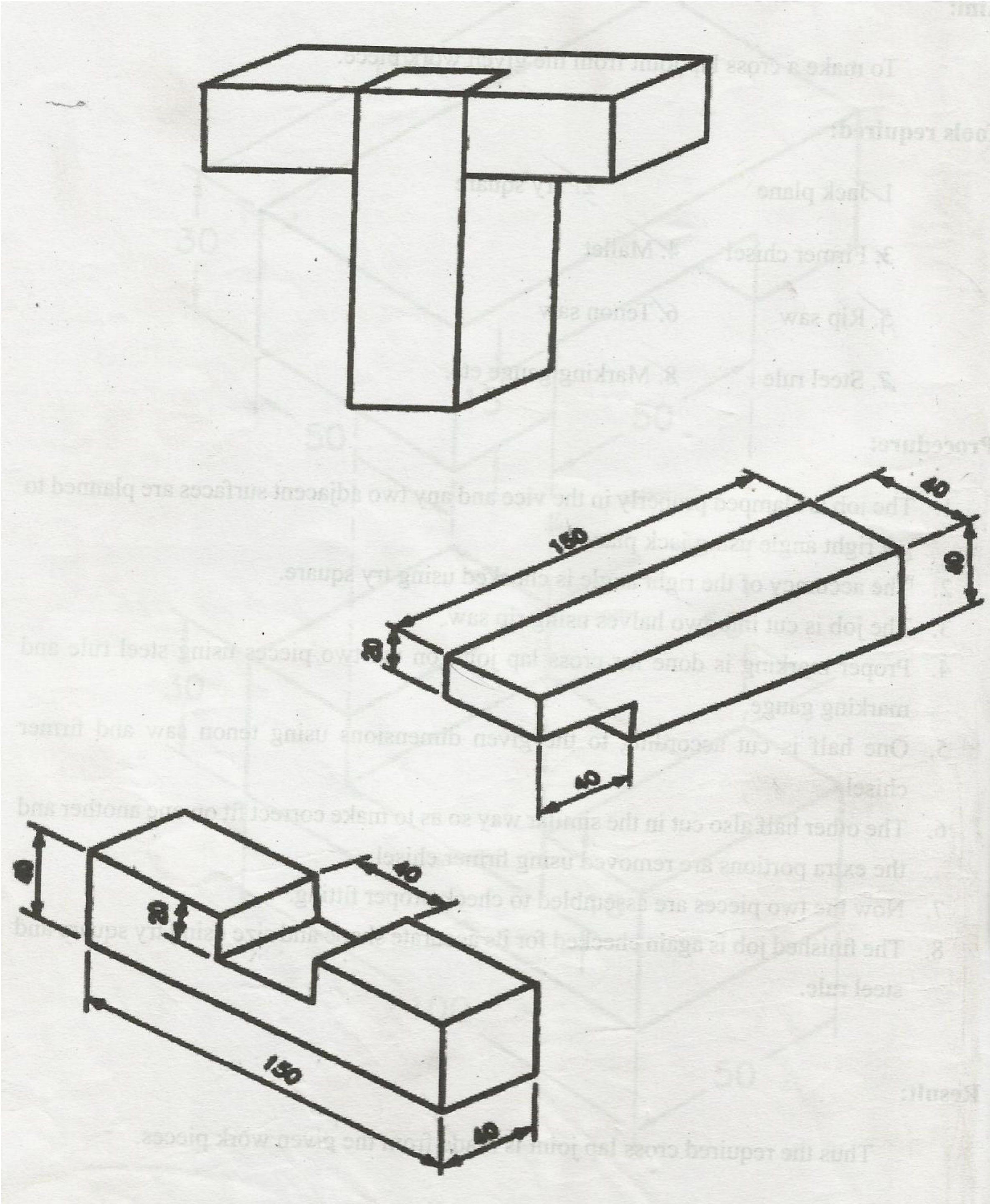
Procedure

1. The given workpiece is firmly clamped in the bench vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planed faces are checked.
3. Now the other two surfaces are planed to get smooth surface.
4. Based on the planed surfaces, the markings are made on the two sides by using marking gauge.
5. After marking, the workpiece is planed such that it should have required dimensions.
6. Finally, the finished job is checked for required size using the steel rule and try square.

Result

Thus the required Dimension is obtained by planing.

TEE LAP - JOINT



All dimensions in 'mm'

Ex.No: **TEE LAP - JOINT** Date

Aim

To make a Tee lap –joint from the given workpiece.

Material Required

Soft wood of size 300x50x50 mm.

Tools Required

1. Jackplane
2. Bench vice
3. Try square
4. Marking gauge
5. Steel rule
6. Tenon saw
7. Rip saw
8. Firmer chisel
9. Mallet

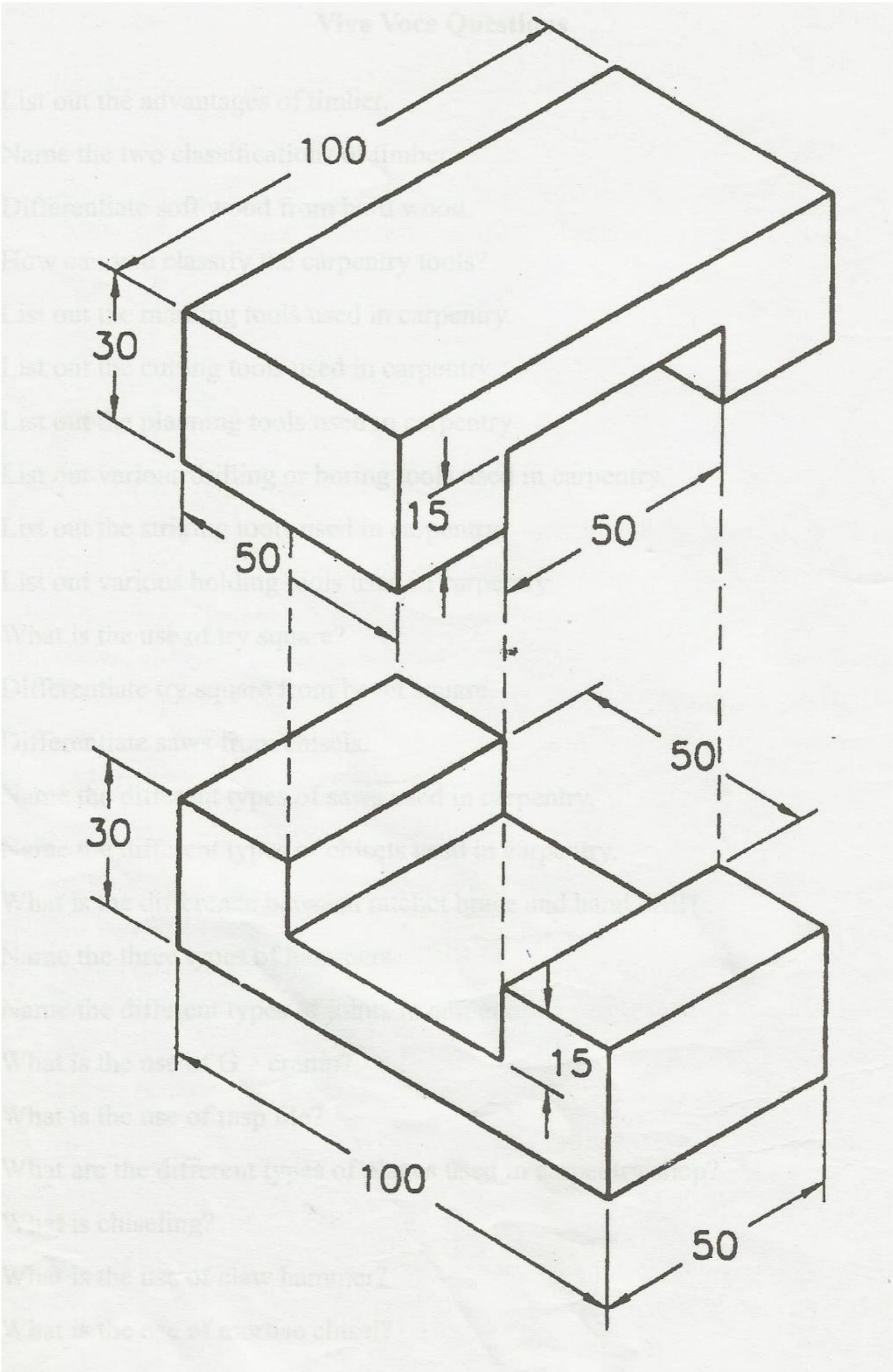
Procedure

1. The given workpiece is firmly clamped in the carpentry vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planed faces are checked.
3. Now the other two surfaces are planed to get smooth surface.
4. The workpiece is cut into two pieces by using the rip saw.
5. Using the steel rule and marking gauge, marking is done for T-joint on the two halves.
6. In one half, the unwanted portions of wood are removed by using the tenon saw and firmer chisel. The same procedure is done for the other half of workpiece.
7. Using the jack plane, the other two faces of workpiece is planed to the required size.
8. The finished two pieces are assembled to getter to form the T-joint.
9. Finally, the finished job is checked for required size and shape using the steel rule and try square.

Result

Thus the required Tee lap -joint is obtained.

CROSS LAP JOINT



All dimensions in 'mm'

Ex.No: **CROSS LAP JOINT** Date

Aim

To make a Cross lap joint from the given workpiece.

Material Required

Soft wood of size 300x50x50 mm.

Tools Required

1. Jackplane
2. Bench vice
3. Try square
4. Marking gauge
5. Steel rule
6. Tenon saw
7. Rip saw
8. Firmer chisel
9. Mallet

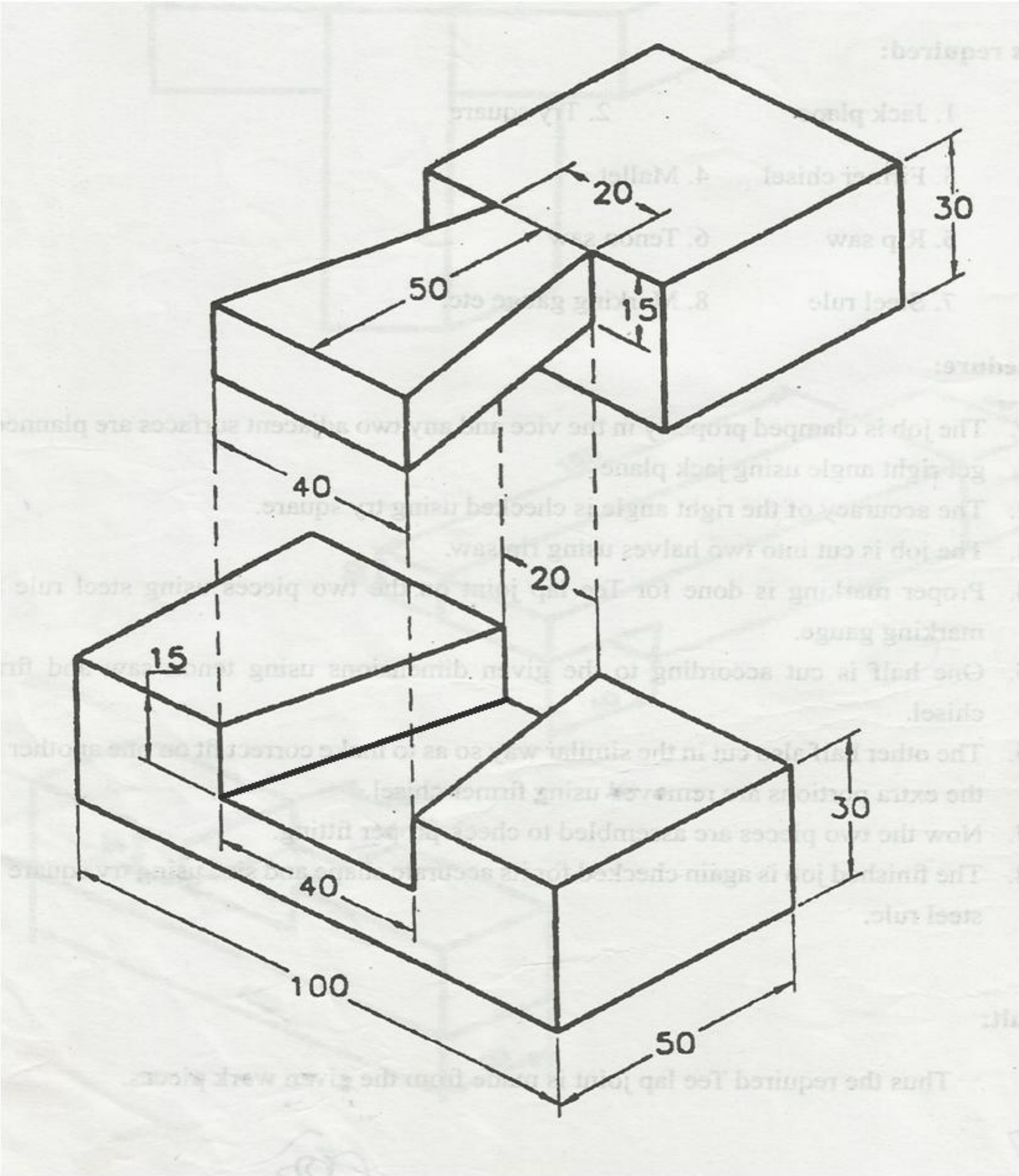
Procedure

1. The given workpiece is firmly clamped in the Bench vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planed faces are checked.
3. Now the other two surfaces are planed to get smooth surface.
4. The workpiece is cut into two pieces by using the rip saw.
5. Mark the dimensions for the Cross lap joint on the two pieces using the steel rule and marking gauge.
6. Remove the unwanted portions as per the drawing and assemble to check proper fitting.

Result

Thus the desired Cross lap joint is obtained.

DOVETAIL HALVING JOINT



All dimensions in ‘mm’

Ex.No: **DOVETAIL HALVING JOINT** Date

Aim

To make a dovetail halving joint from the given workpiece.

Material Required

Soft wood of size 300x50x50 mm.

Tools Required

1. Jackplane
2. Bench vice
3. Try square
4. Mortise gauge
5. Mallet
6. Firmer chiesel

Procedure

1. The given workpiece is firmly clamped in the Bench vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planed faces are checked.
3. Now the other two surfaces are planed to get smooth surface.
4. The workpiece is cut into two pieces by using the rip saw.
5. Mark the dimensions for the dovetail joint on the two pieces using the steel rule and marking gauge.
6. Remove the unwanted portions as per the drawing and assemble to check proper fitting.

Result

Thus the desired dovetail halving joint is obtained.

PLUMBING

PLUMBING

INTRODUCTION

Plumbing deals with the laying of a pipeline. A craftsman may be perfectly proficient with the hammer, saw and other tools, but the faces difficulties with leaking pipes and overflowing toilets. Many people rush to a plumber on seeking a tripping pipe, but a person with a little knowledge of the sanitary system can control this problem easily, saving time and, one with help of few tools.

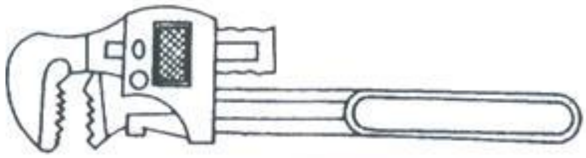
STUDY OF PLUMBING TOOLS

The tools used by a plumber can be classified as follows

1. Pipe wrench
2. Pipe vice
3. Pipe cutter
4. Hacksaw
5. Dies

1. Pipe wrench

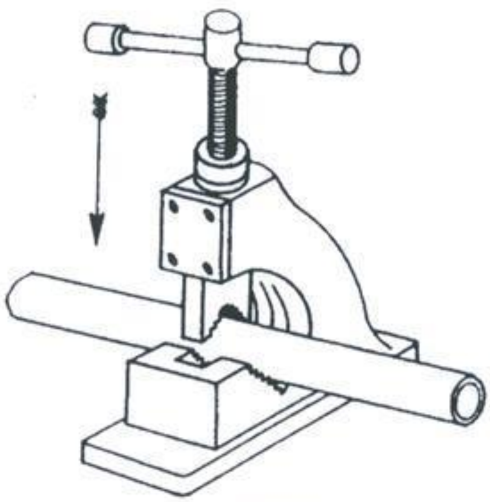
A pipe wrench is used for holding and turning the pipes, rods and machine parts. Wrenches are classified as follows.1.Fixed wrenches 2. Adjustable wrenches.



Pipe wrench.

2. Pipe vice

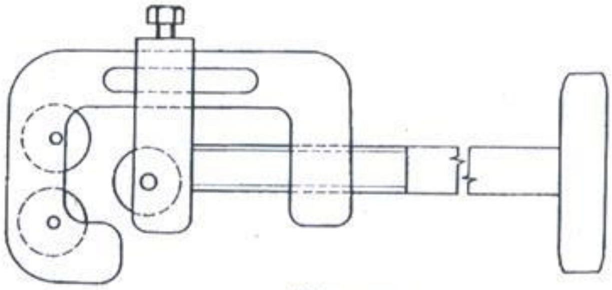
A pipe vice is fitted on the work bench. This has a set of jaws to grip the pipe and prevent it from turning while cutting, threading and fitting of bends, couplings etc. The yoke vice is commonly used in plumbing used in plumbing practice.



Pipe vice.

3. Pipe cutter

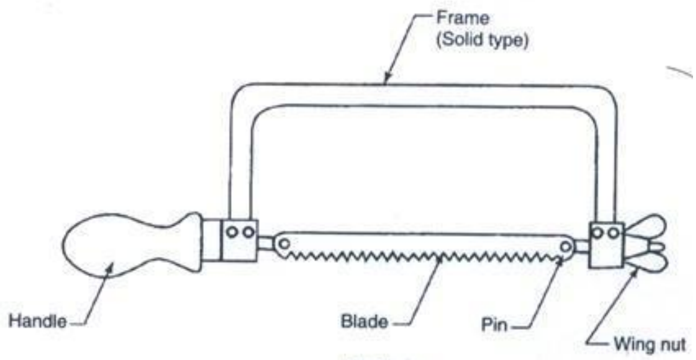
The pipe cutter mainly consists of three wheels which are hardened with sharp cutting edges along their periphery. Of these three wheels, one can be adjusted to any desired distance to accommodate different size of pipes. After adjusting the cutter on a pipe, it is around the pipe, so that the cutter wheels cut the pipe along a circle as shown in the figure.



Pipe cutter.

4. Hack saw

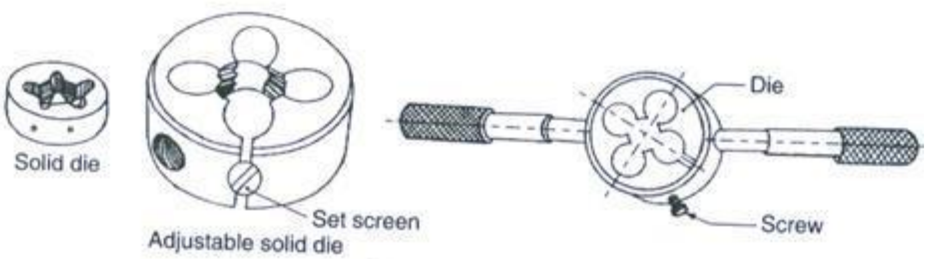
A hacksaw is used for cutting metal rods, bars, pipes, etc.



Hacksaw.

5. Dies

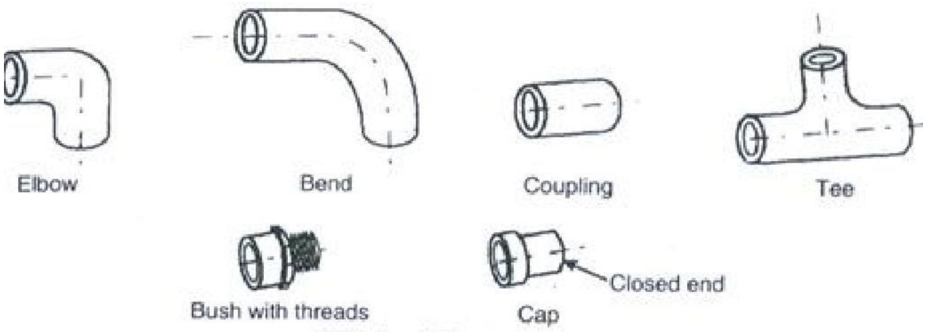
It is used for cutting external thread on pipes. Threads are produced in various shape and sizes which are used for fitting inside a handle.



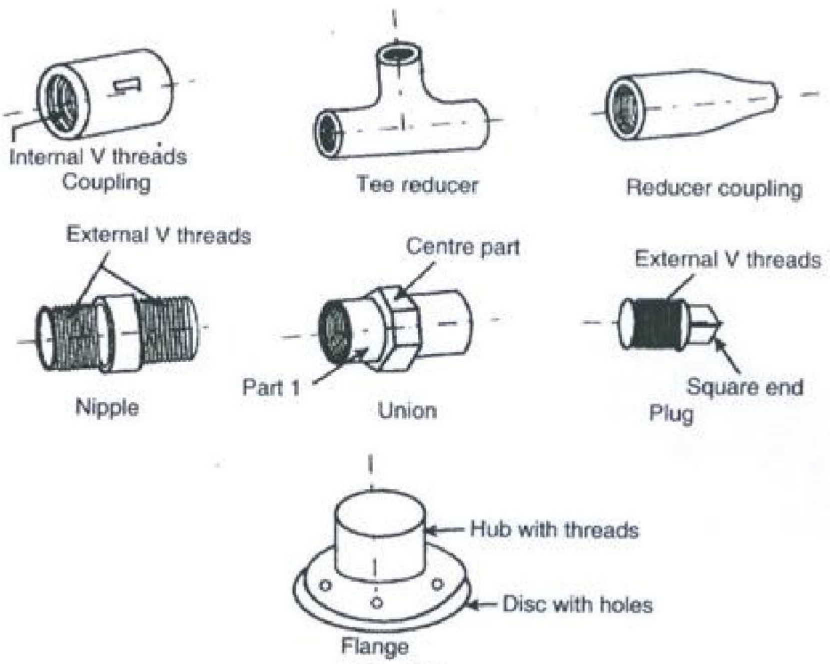
Threading dies and taps.

PIPE FITTINGS

Pipe fittings are made up of wrought iron. The size of pipe fitting is designated by the size of the pipe on which it fits. Some of the common pipe fittings are shown in figure



PVC pipe fittings



Pipe fittings.

1. Coupling

It is a short a cylindrical sleeve with internal threads throughout. A couplings is used for joining two pipes in a straight and bend where at least one pipe can be turned.

2. Union

A union is used for joining two pieces of pipes, where either can be turned. It consists of three parts, two parts joint can be screwed, in to two pipe ends, and the third on for tightening called centre part.

3. Nipple

A nipple is a short piece of pipe with external threads at both ends. It is used to make up the required length of a pipe line.

4. Elbow

An elbow is to make an angle between adjacent pipes.

5. Tee

A tee is a fitting that has one side outlet at a right angle to the run. It is used for a single outlet branch pipe.

6. Reducer

It is used to connect two different sized of pipes

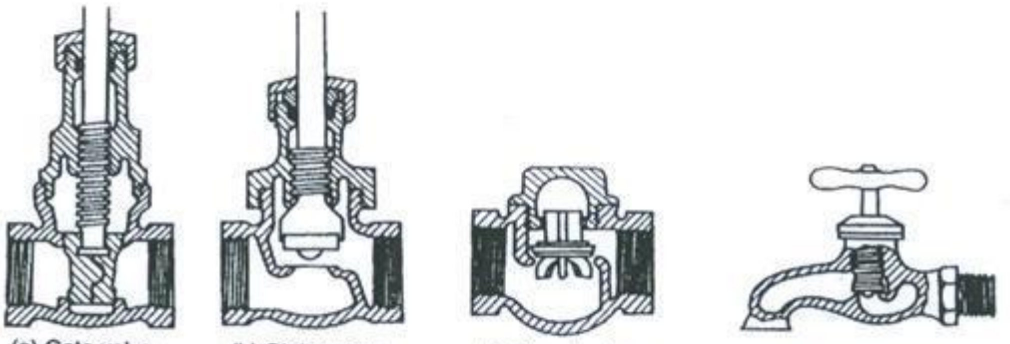
7. Plug

It is used to screw on to a threaded opening, for closing it temporarily.

VALVES

Valves are used for regulating the flow of fluid through a pipe. The commonly used valves in plumbing's are

1. Gate valve 2.Globe valve 3. Plug valve
4. Check valve 5. Air relief valve.



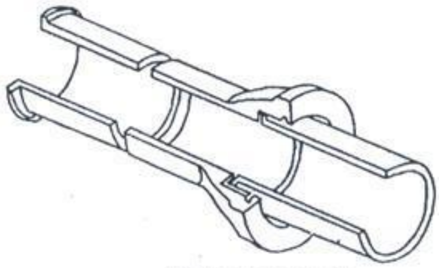
(a) Gate valve (b) Globe valve (c) Check valve (d) Common tap

Valves.

TYPES OF PIPE JOINTS

1. Bell and spigot joints

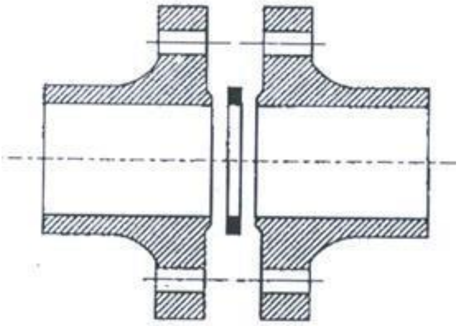
A connection between two sections of pipe i.e. the straight spigot end of one section is inserted into the flared out end of the adjoining section. The joint is sealed by a sealing component.



Bell and spigot joints.

2. Flanged joints

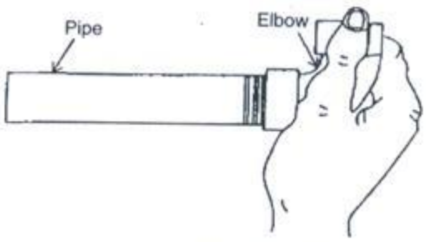
A flanged joint helps to connect and disconnect two pipes as per the need. A similar example is as shown in figure.



Flange joint.

3. Threaded joints

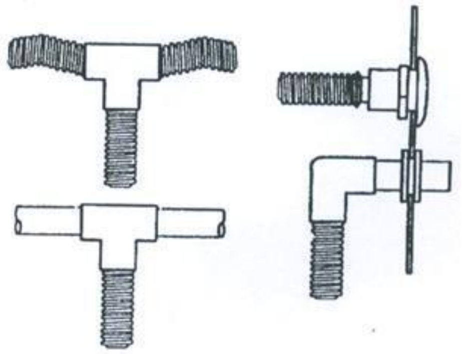
Threads are formed in a pipe, flange coupling to connect them with each other and these joints are called threaded joints.



Threaded joint.

4. Flexible joints

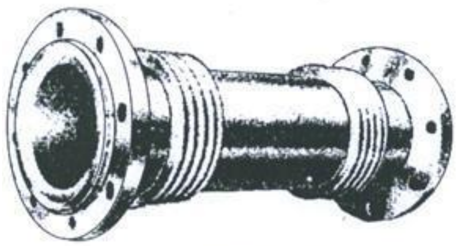
The flexible joints are generally used to connect between a washbasin and an angle valve.



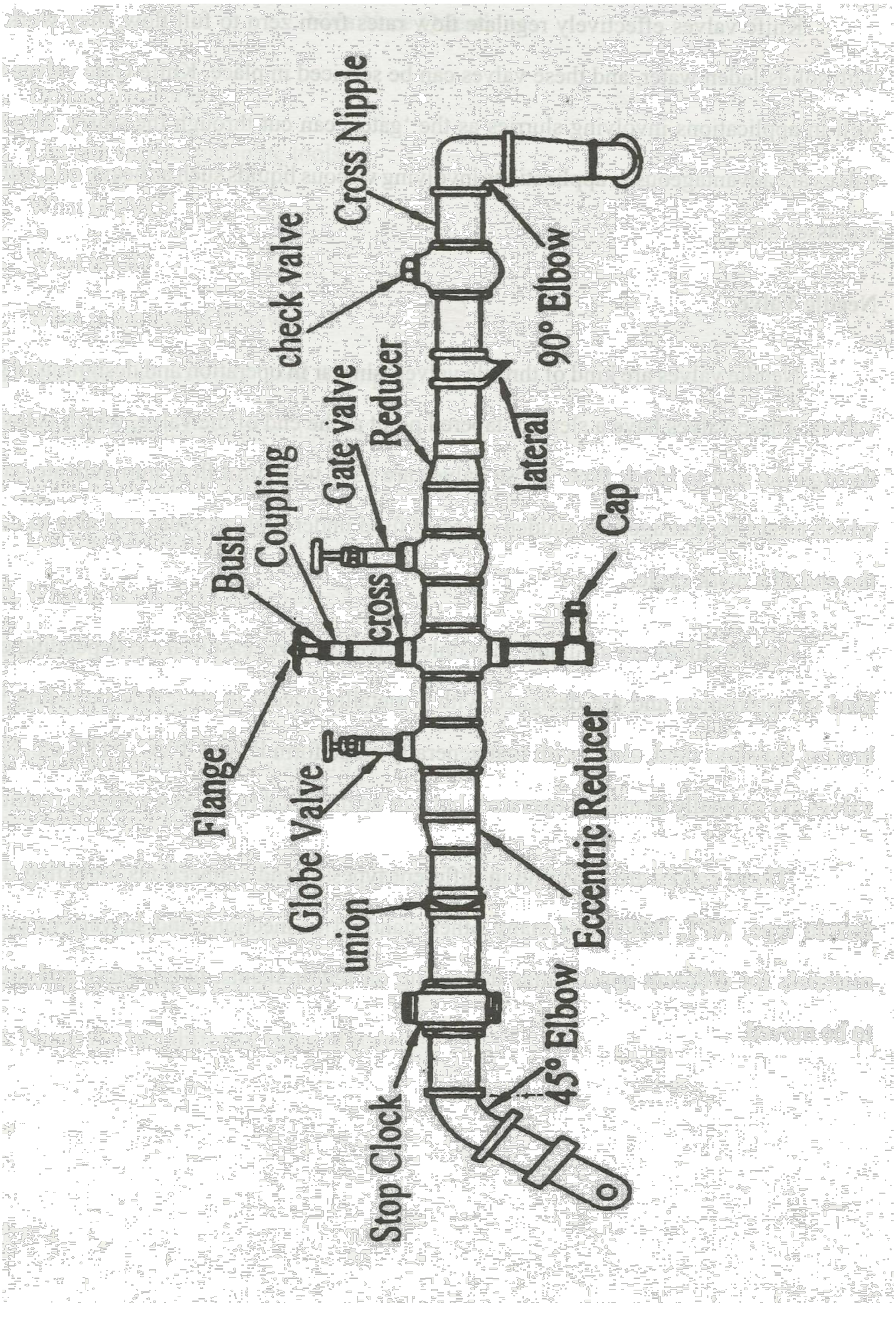
Flexible joints.

5. Expansion joints

Expansions joints are specially designed in pipeline where a small extension of pipe is required.

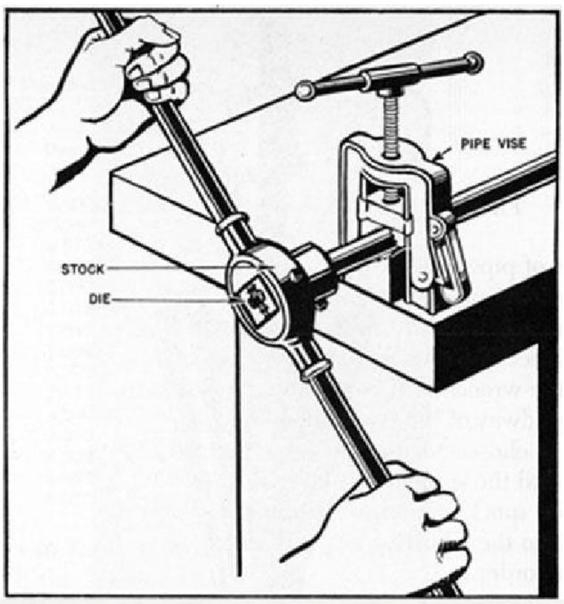


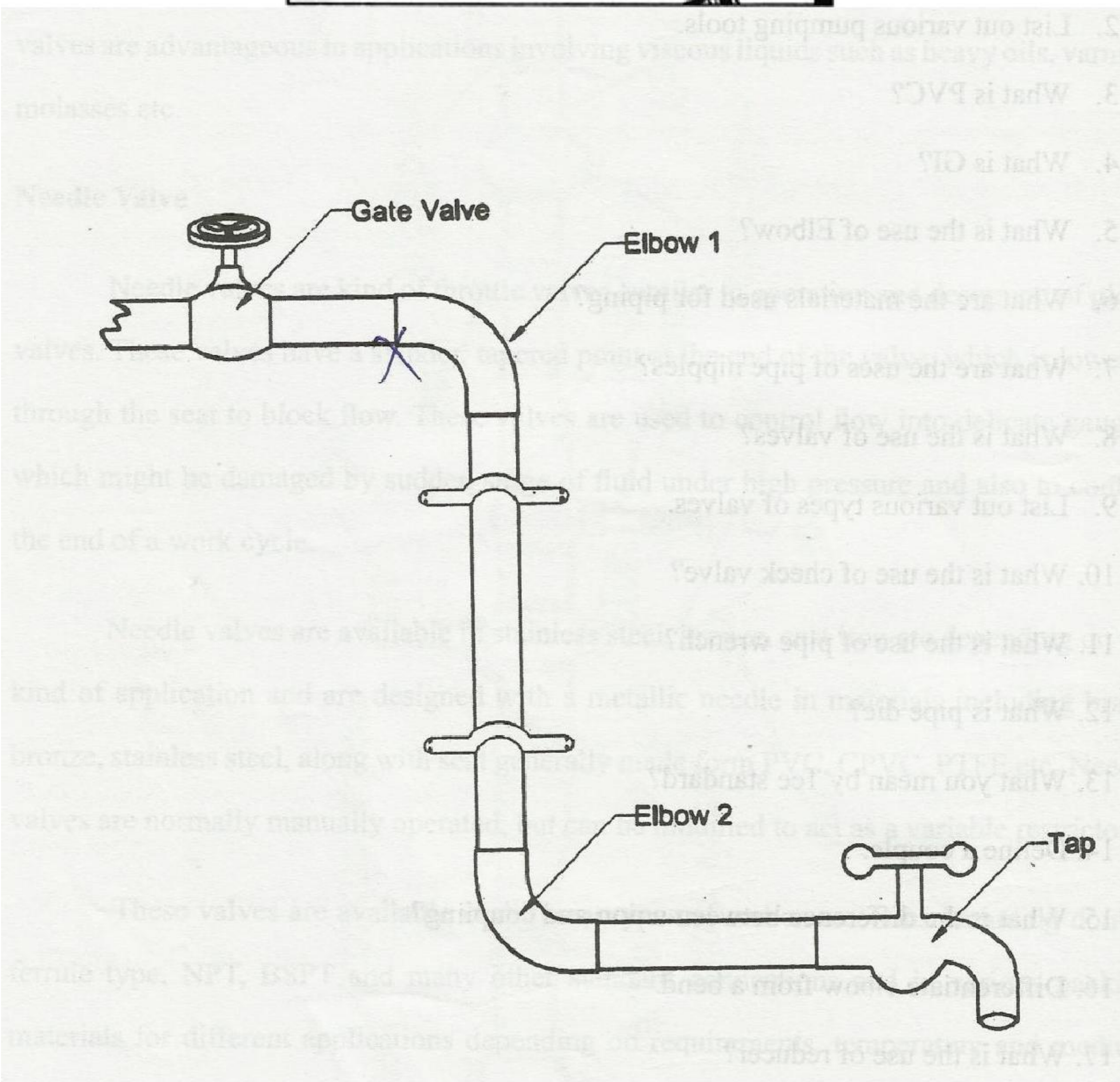
Expansion joints.



LAYOUT OF A SIMPLE PIPE CONNECTION

PIPE THREADING





Ex.No: **PIPE THREADING** Date

Aim

To cut the threads at the end of the given PVC pipe by using a pipe die and to make the Plumbing.

Material Required

1. PVC pipe
2. Elbows
3. Tap
4. Valve
5. Clamps

Tools Required

1. Pipe vice
2. Die
3. Die stock
4. Measuring scale

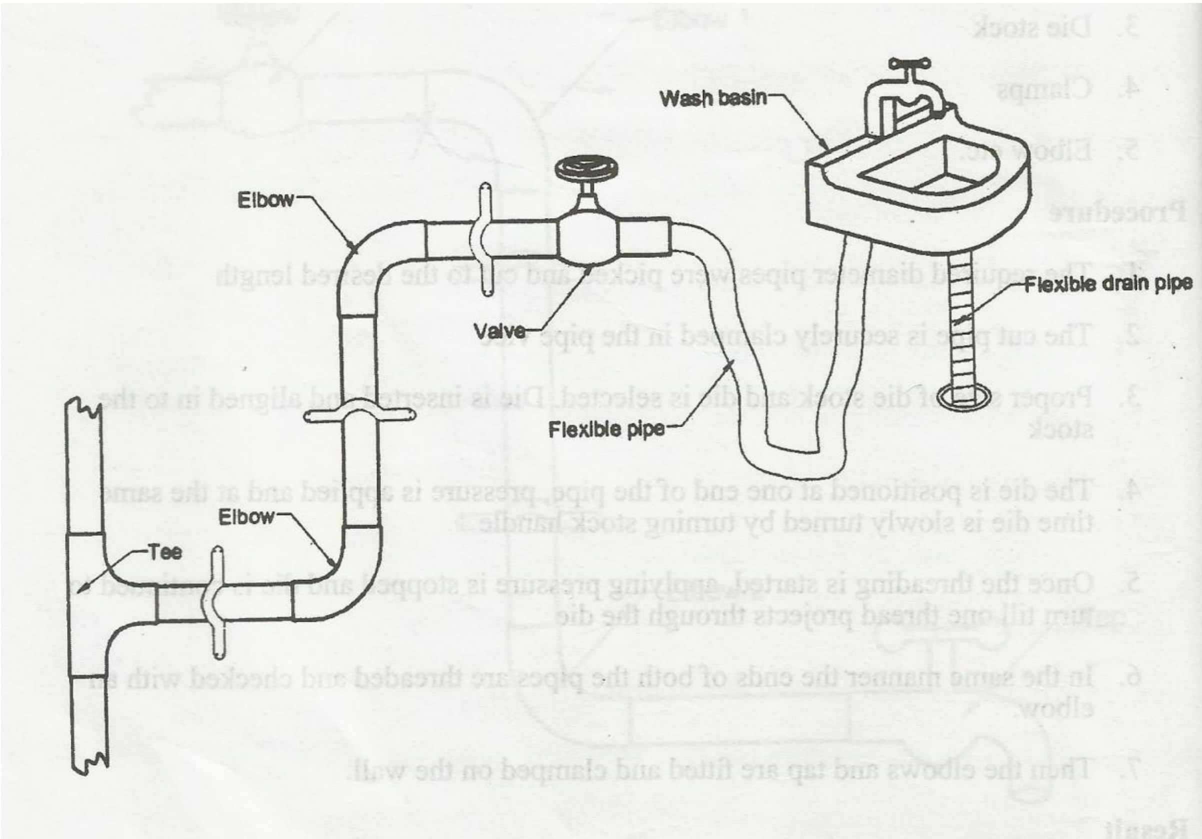
Procedure

1. The required diameter pipes were picked and cut to the desired length
2. The cut pipe is securely clamped in the pipe vice
3. Proper size of die stock and die is selected. It is inserted and aligned into the stock
4. The die is positioned at one end of the pipe, Pressure is applied and at the same time die is slowly turned by turning stock handle
5. Once the threading is started, applying pressure is stopped and die is continued to turn till one thread projects through the die
6. In the same manner the ends of the pipes are threaded and checked with an elbow
7. Then the elbow and tap are fitted and clamped on the wall

Result

Thus the threads cut at the ends of PVC pipe to make plumbing

PIPE LINE TO WASH BASIN



Ex.No: **PIPE LINE TO WASH BASIN** Date

Aim

To prepare a pipe line connection to the wash basin.

Material Required

1. PVC pipe
2. Elbows
3. Flexible pipe
4. Valve
5. Clamps
6. Wash basin with tap
7. Tee Joint

Tools Required

1. Pipe wrench
2. Hammer
3. Screw driver
4. Hack saw

Procedure

1. Mark location of the wash basin and fix it
2. Fix the wash basin tap in the required position
3. Make the tee and elbow connections in the main pipe line to connect it to the wash basin and taps
4. Fix the gate valve near the water tank
5. Connect all the pipe fittings as per the diagram
6. The water tank was filled with water and the gate valve was opened slowly to supply water into the pipe line
7. The tap were opened to check its function

Result

Thus the pipe line connection to the wash basin is made.

Valliammai Engineering College

SRM Nagar, Kattankulathur - 603203

Department of Electrical and Electronics Engineering

GE6162 – ENGINEERING PRACTICES LABORATORY

ELECTRICAL

LAB MANUAL

I Year- I Semester

Academic Year 2015-2016

(2013Regulation)

MECHANICAL ENGINEERING PRACTICE

List of Experiments

1. To make a butt joint on the given work pieces using arc welding.
2. To make a lap joint on the given work pieces using arc welding.
3. To make a Tee joint on the given work pieces using arc welding.
4. To perform turning, facing and chamfering on a cylindrical work piece.
5. To perform taper turning operation on a cylindrical work piece.
6. To make an internal thread on a given work piece as per the required dimensions using drilling machine and tapping tool.
7. To make a hollow cone out of the given sheet with specified dimensions.
8. To make a rectangular tray out of the given sheet with specified dimensions.

WELDING

WELDING

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld puddle) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.

Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, underwater and in space. Regardless of location, however, welding remains dangerous, and precautions must be taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light.

TYPES OF WELDING

Arc Welding

Arc welding is a process utilizing the concentrated heat of an electric arc to join metal by fusion of the parent metal and the addition of metal to joint usually provided by a consumable electrode. Either direct or alternating current may be used for the arc, depending upon the material to be welded and the electrode used.

Gas Welding

It is a metal joining process in which the ends of pieces to be joined are heated at their interface by producing coalescence with one or more gas flames (such as oxygen and acetylene), with or without the use of a filler metal.

Welding Safety

Welding hazards pose an unusual combination of safety and health risks. By its nature, welding produces fumes and noise, gives off radiation, involves electricity or gases, and has the potential for burns, shock, fire, and explosions.

Some hazards are common to both electric arc and oxygen-fuel gas welding. If you work with or near a welding operation, the following general precautions should help you to work more safely.

- Weld only in designated areas.
- Only operate welding equipment you have been trained to use.
- Know what the substance is that’s being welded and any coating on it.
- Wear protective clothing to cover all exposed areas of the body for protection sparks, hot spatter, and radiation.
- Protective clothing should be dry and free of holes, grease, oil, and other substances which may burn.
- Wear flameproof gauntlet gloves, a leather or asbestos apron, and high-top shoes to provide good protection against sparks and spatter.
- Wear specifically designed, leak-proof helmets equipped with filter plates to protect against ultraviolet, infrared, and visible radiation.
- Never look at a flash, even for an instant.

- Keep your head away from the plume by staying back and to the side of the work.
- Use your helmet and head position to minimize fume inhalation in your breathing zone.
- Make sure there is good local exhaust ventilation to keep the air in your breathing zone clear.
- Don’t weld in a confined space without adequate ventilation and a NIOSH-approved respirator.
- Don’t weld in wet areas, wear wet or damp clothing or weld with wet hands.
- Don’t weld on containers which have held combustible materials or on drums, barrels or tanks until proper safety precautions have been taken to prevent explosions.
- If others are working in the area be sure they are warned and protected against arcs, fumes, sparks, and other welding hazards.

- Don't coil the electrode cable around your body.
- Ground both the frame of the welding equipment and metal being welded.
- Check for leaks in gas hoses using an inert gas.
- Check area around you before welding to be sure no flammable material or degreasing solvents are in the welding area.
- Keep a fire watch in the area during and after welding to be sure there are no smoldering materials, hot slag or live sparks which could start a fire.
- Locate the nearest fire extinguisher before welding.
- Deposit all scraps and electrode butts in proper waste container to avoid fire and toxic fumes.

Types of arc welding

Different types of arc welding are.

1. Carbon arc welding
2. Metal arc welding
3. Metal inert gas welding
4. Submerged arc welding
5. Plasma arc welding etc.

Electric Arc Welding,

Electric arc welding is the most widely used of the various arc welding processes. Welding is performed with the heat of an electric arc that is maintained between the end of a coated metal electrode and the work piece (See Figure 1). The heat produced by the arc melts the base metal, the electrode core rod, and the coating. As the molten metal droplets are transferred across the arc and into the molten weld puddle, they are shielded from the atmosphere by the gases produced from the decomposition of the flux coating. The molten slag floats to the top of the weld puddle where it protects the weld metal from the atmosphere during solidification. Other functions of the coating are to provide arc stability and control bead shape. More information on coating functions will be covered in subsequent lessons.

Welding Power Sources: Shielded metal arc welding may utilize either alternating current (AC) or direct current (DC), but in either case, the power source selected must be of the constant current type. This type of power source will deliver relatively constant amperage or welding current regardless of arc length variations by the operator the amperage determines the amount of heat at the arc and since it will remain relatively constant, the weld beads produced will be uniform in size and shape.

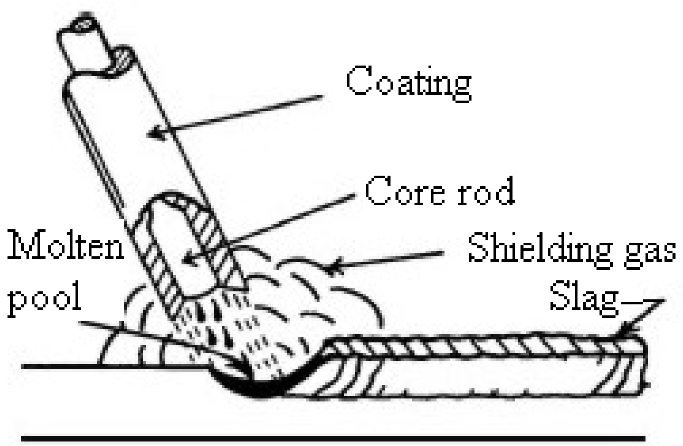
Whether to use an AC, DC, or AC/DC power source depends on the type of welding to be done and the electrodes used. The following factors should be considered: 1**. Electrode Selection** - Using a DC power source allows the use of a greater range of electrode types. While most of the electrodes are designed to be used on AC or DC, some will work properly only on DC.

2. Metal Thickness - DC power sources may be used for welding both heavy sections and light gauge work. Sheet metal is more easily welded with DC because it is easier to strike and maintain the DC arc at low currents.

3. Distance from Work - If the distance from the work to the power source is great, AC is the best choice since the voltage drop through the cables is lower than with DC. Even though welding cables are made of copper or aluminum (both good conductors), the resistance in the cables becomes greater as the cable length increases. In other words, a voltage reading taken between the electrode and the work will be somewhat lower than a reading taken at the output terminals of the power source. This is known as voltage drop.

4. Welding Position - Because DC may be operated at lower welding currents, it is more suitable for overhead and vertical welding than AC. AC can successfully be used for out-of-position work if proper electrodes are selected.

5. Arc Blow - When welding with DC, magnetic fields are set up throughout the weldment. In weldments that have varying thickness and protrusions, this magnetic field can affect the arc by making it stray or fluctuate in direction. This condition is especially troublesome when welding in corners. AC seldom causes this problem because of the rapidly reversing magnetic field produced.



Oxy-Acetylene gas Welding

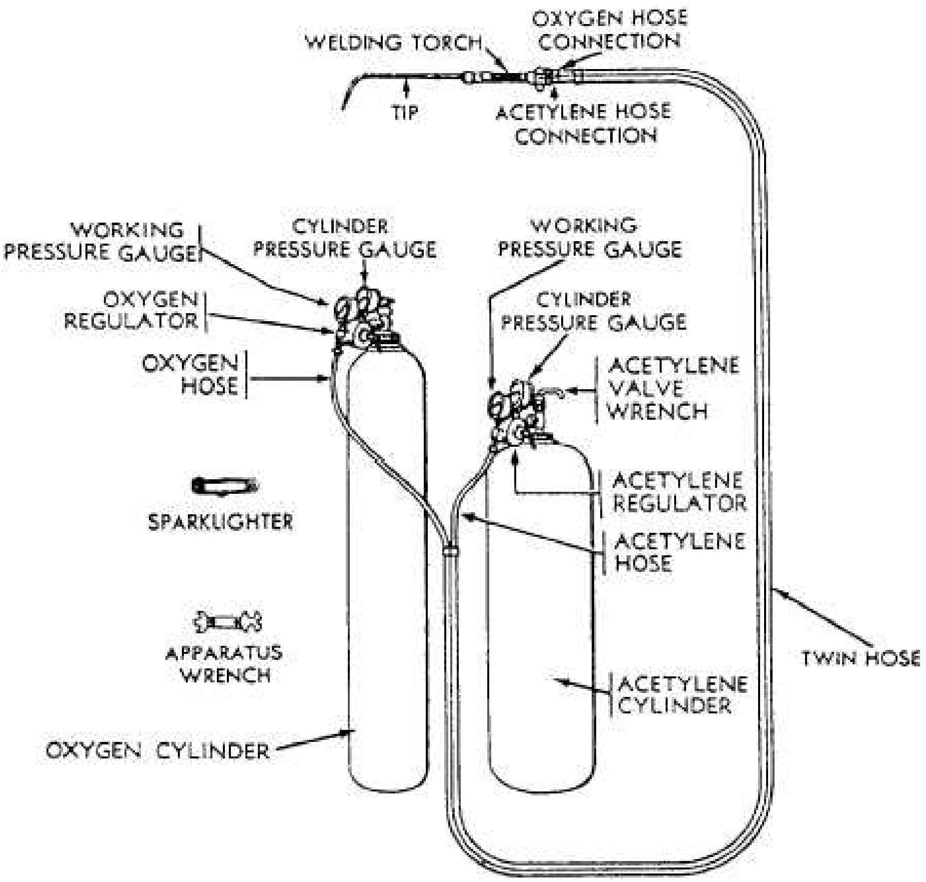
Oxyacetylene welding, commonly referred to as gas welding, is a process which relies on combustion of oxygen and acetylene. When mixed together in correct proportions within a hand-held torch or blowpipe, a relatively hot flame is produced with a temperature of about 3,200˚C. The chemical action of the oxyacetylene flame can be adjusted by changing the ratio of the volume of oxygen to acetylene.

Three distinct flame settings are used, neutral, oxidising and carburizing. Welding is generally carried out using the neutral flame setting which has equal quantities of oxygen and acetylene. The oxidising flame is obtained by increasing just the oxygen flow rate while the carburising flame is achieved by increasing acetylene flow in relation to oxygen flow. Because steel melts at a temperature above 1,500˚C, the mixture of oxygen and acetylene is used as it is the only gas combination with enough heat to weld steel. However, other gases such as propane, hydrogen and coal gas can be used for joining lower melting point non-ferrous metals, and for brazing and silver soldering.

Equipment

Oxyacetylene equipment is portable and easy to use. It comprises oxygen and acetylene gases stored under pressure in steel cylinders. The cylinders are fitted with regulators and flexible hoses which lead to the blowpipe. Specially designed safety devices such as flame traps are fitted between the hoses and the cylinder regulators. The flame trap prevents flames generated by a 'flashback' from reaching the cylinders; principal causes of flashbacks are the failure to purge the hoses and overheating of the blowpipe nozzle.

When welding, the operator must wear protective clothing and tinted coloured goggles. As the flame is less intense than an arc and very little UV is emitted, general-purpose tinted goggles provide sufficient protection



Neutral Flame

As the supply of oxygen to the blowpipe is further increased; the flame contracts and the white cone become clearly defined, assuming a definite rounded shape. At this stage approximately equal quantities of acetylene and oxygen are being used and the combustion is complete, all the carbon supplied by the acetylene is being consumed and the maximum heat given out. The flame is now neutral, and this type of flame is the one most extensively used by the welder, who should make himself thoroughly familiar with its appearance and characteristics.

Carburising Flame

This is a flame in which an excess of acetylene is burning, i.e. combustion is incomplete and unconsumed carbon is present. When lighting the blowpipe the acetylene is turned on first and ignited, giving a very smoky yellow flame of abnormal size, showing two cones of flame in addition to an outer envelope; this is an exaggerated form of the carburising flame, but gives out comparatively little heat and is of little use for welding.

Oxidising Flame

A further increase in the oxygen supply will produce an oxidising flame in which there is more oxygen than is required for complete combustion. The inner cone will become shorter and sharper, the flame will turn a deeper purple colour and emit a characteristic slight "hiss", while the molten metal will be less fluid and tranquil during welding and excessive sparking will occur. An oxidising flame is only used for special applications, and should never be used for welding

Welding Tools and Safety Equipments

Goggles

Goggles are forms of protective eyewear that usually enclose or protect the eye area in order to prevent particulates, infectious fluids, or chemicals from striking.

Face Shield

Face shield is used to protect the eyes of the welder from the little sparks produced during welding. It is normally held in hand.

Hand Gloves

Hand gloves are used to protect the hands from electrical shock, arc radiation and hot spatters.

Tongs

Tongs are used to handle the hot metal – welding job while cleaning. They are also used to hold the metal for hammering.

Chipping Hammer

Chipping hammer is a chisel shaped tool and is used to remove the slag from the weld bead.

Wire brush

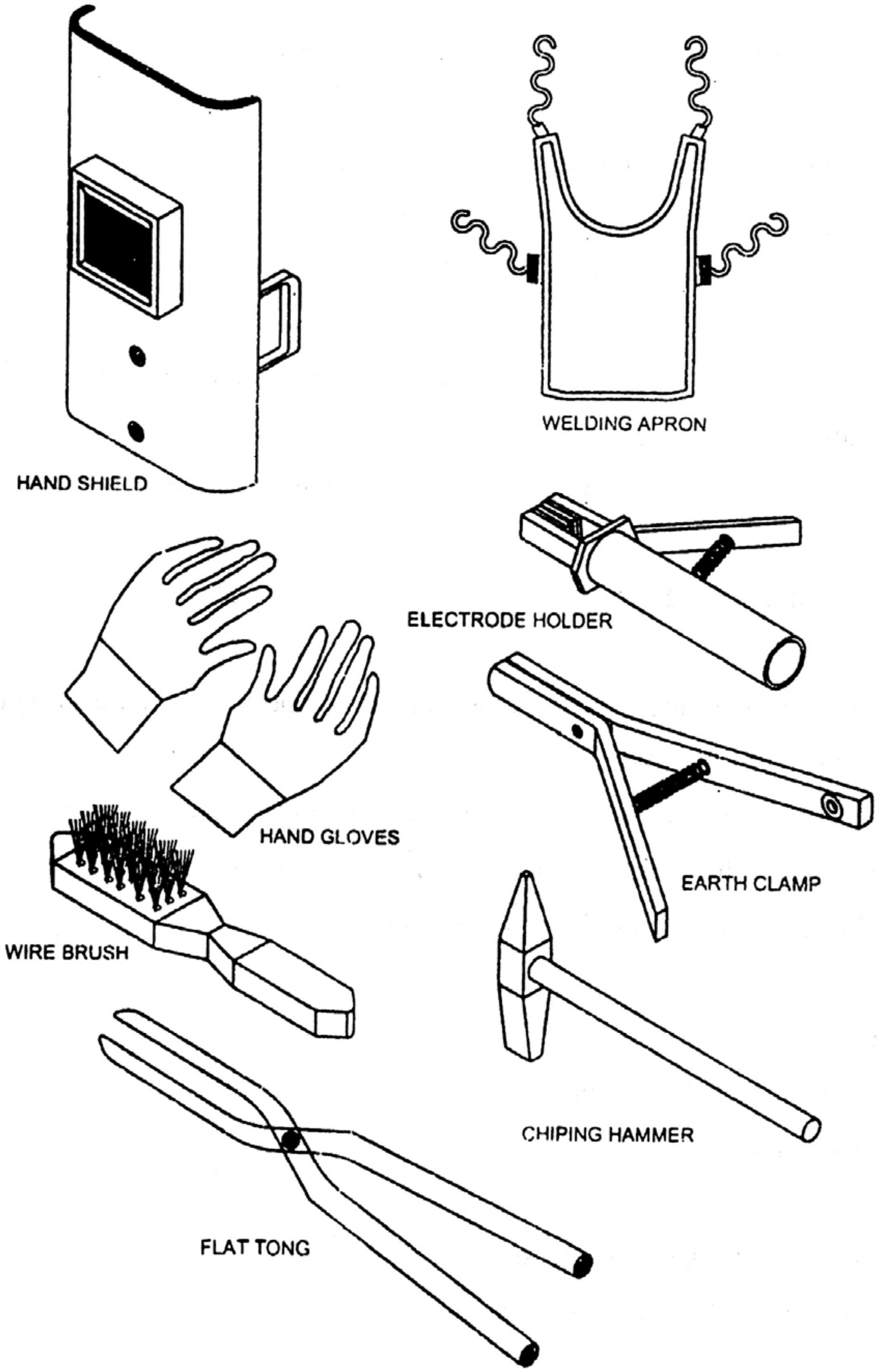
A wire brush is made up of stiff steel wire embedded in a wooden piece. It removes small particles of slag from the weld bead after the chipping hammer has done its job.

Welding Helmet

Welding helmets are headgear used when performing certain types of welding to protect the eyes , face and neck from flash burn, ultraviolet light, sparks and heat. Welding helmets can also prevent retina burns, which can lead to a loss of vision.

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.


WELDING APRON
HAND SHIELD
ELECTRODE HOLDER
HAND GLOVES
EARTH CLAMP
WIRE BRUSH
CHIPING HAMMER
FLAT TONG

Advantages of Arc Welding

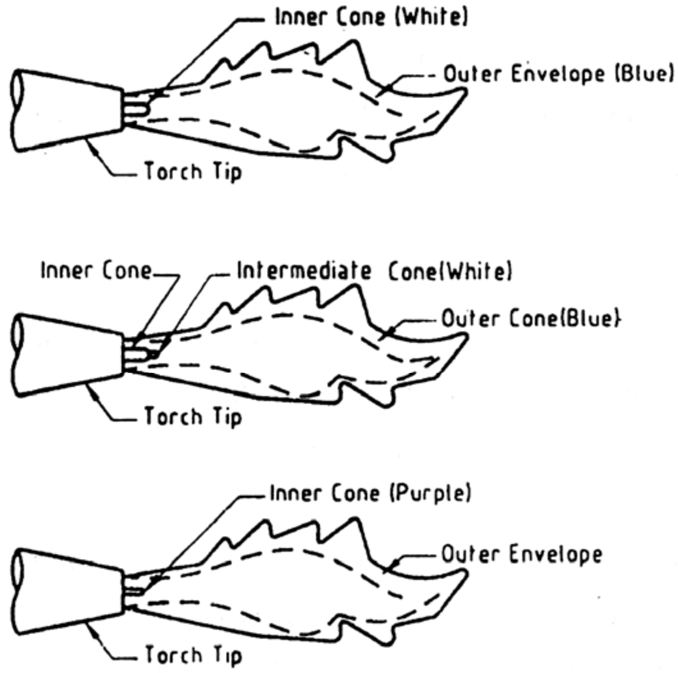
1. A big range of metals and their alloys can be welded
2. Welding equipment is portable and the cost is fairly low
3. Flux shielded manual metal arc welding is the simplest of all the arc welding processes.
4. The applications of the arc welding are innumerable, because of the availability of wide variety of electrodes.
5. Welding can be carried out in any position with highest weld quality.

Disadvantages of arc welding

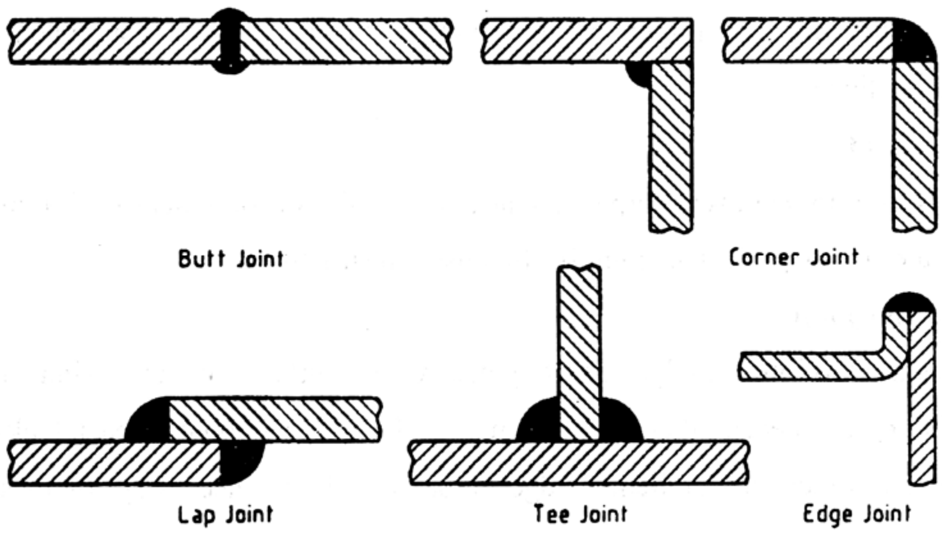
1. Because of the limited length of each electrode and brittle flux coating on it, mechanization is difficult.
2. In welding long joints, as one electrode finishes, the weld is to be progressed with the next electrode. A defect may occur at the place where welding is restarted with the new electrode.

Applications

1. In reservoir tank, boiler and pressure vessel fabrications
2. Ship building
3. Pipes and pen stock joining
4. Building and bridge construction
5. Automotive and air craft industry



TYPES OF OXY-ACETYLENE FLAME



BASIC TYPES OF WELDED JOINTS

Types of Joints

The joints used in welding are

1. Butt joint 2. Lap joint 3. Edge joint

4. T – joint 5. Corner joint

1. Butt joint

It is used to join the ends or edges of plates lying in the same plane. Plates having thickness less than 5mm do not require edge preparation but plates having thickness more than 5mm require edge preparation on both sides.

2. Lap joint

It is used to join two over lapping pieces so that the edges of each piece are welded to the surface of the other. It is used on plates less than 3mm thickness. Common types are single lap and double lap joint. Edge preparation is not required for these joints.

3. Edge joint

It is used to weld two parallel plates. This is economical for joining thin plates up to 6mm. This joint is often used in sheet metal work. It is suitable for severe loading.

4. T – joint

It is used to weld two perpendicular plates. This is economical for joining thin plates up to 3mm. This joint is often used in structures.

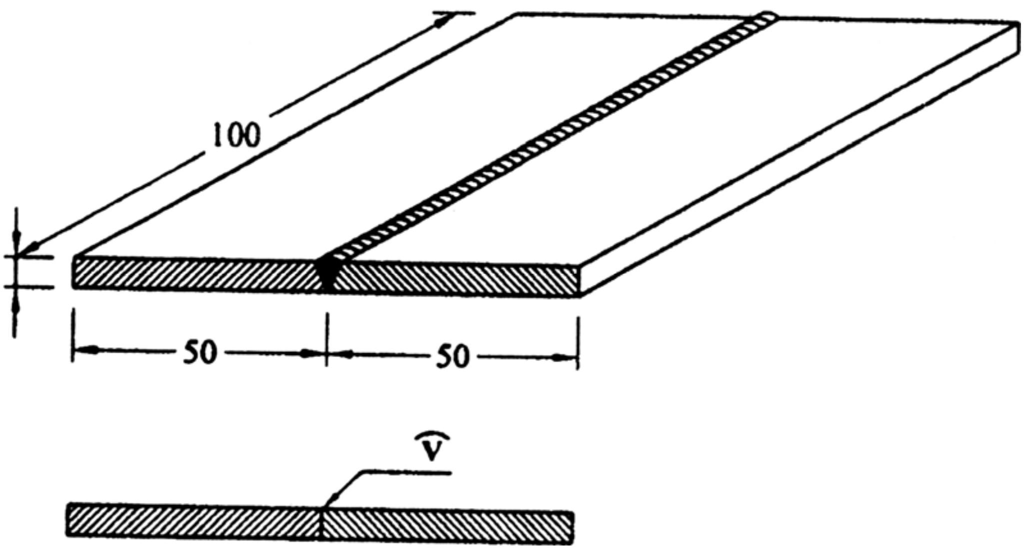
5. Corner joint

It is used to join the edges of two pieces whose surfaces are approximately at right angles to each other. It is common in the construction of boxes, tanks, frames and other similar items. Edge preparation is not necessary for these joints.

Viva Voce Questions

1. What is welding?
2. Name the different types of welding.
3. Explain the principle of arc welding.
4. What is gas welding?
5. Name the different types of flames in gas welding.
6. What is oxidizing flame?
7. What is neutral flame?
8. What is carburizing flame?

9. Name the various parts of gas welding equipment.
10. Name few types of arc welding.
11. What are the differences between arc welding and gas welding?
12. What is meant by filler rod in welding?
13. List out the safety equipments used in welding.
14. What are the advantages of arc welding?
15. What are the disadvantages of arc welding?
16. List out various applications of welding.
17. What are the different types of joints used in welding?
18. Differentiate butt joint from lap joint.
19. What is corner joint?
20. What is the use of goggles?
21. What is the function of flux in welding?
22. What is called slag?
23. What is the use of chipping hammer?
24. List some of the safety measures to be taken in welding.
25. Name the gases used in gas welding.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V

1. BUTT JOINT

Aim:

To make a butt joint on the given work pieces using arc welding.

Apparatus required:

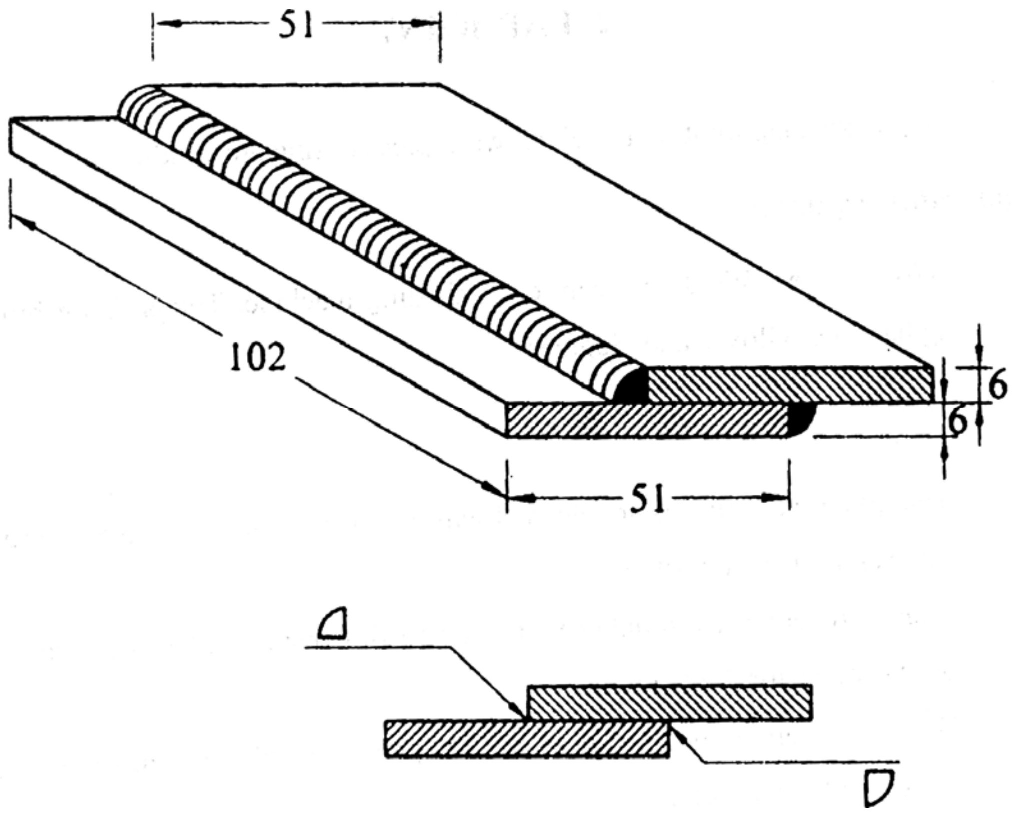
Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, Chipping hammer, Gloves and Goggles.

Procedure:

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned for the butt joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

Result:

Thus the required butt joint is obtained as per the given dimensions.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2. LAP JOINT

Aim:

To make a lap joint on the given work pieces using arc welding.

Apparatus required:

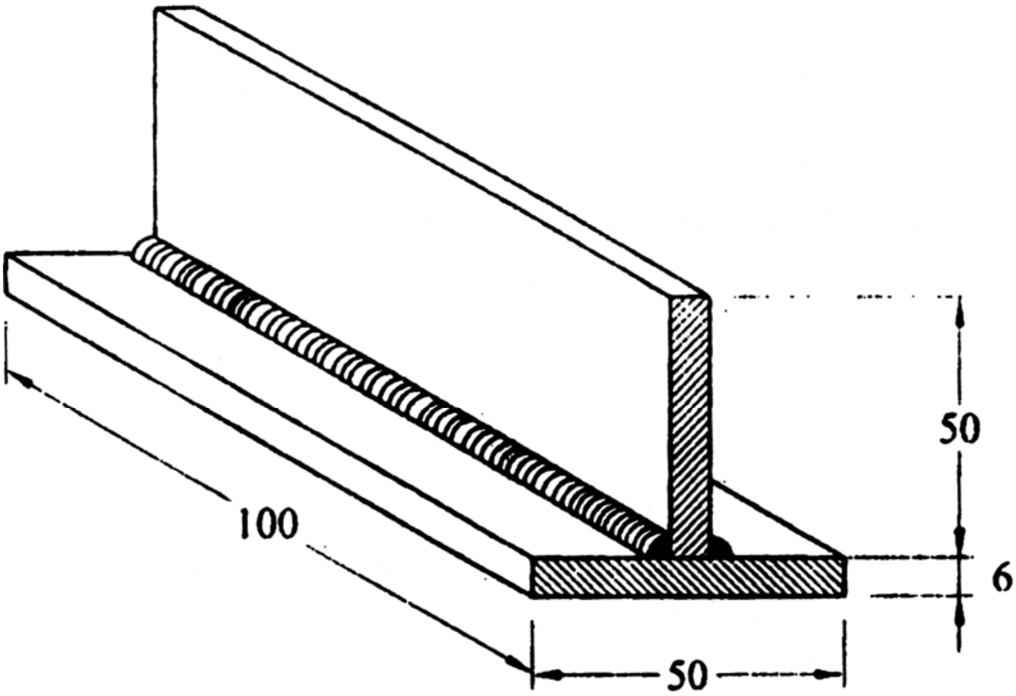
Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, Chipping hammer, Gloves and Goggles.

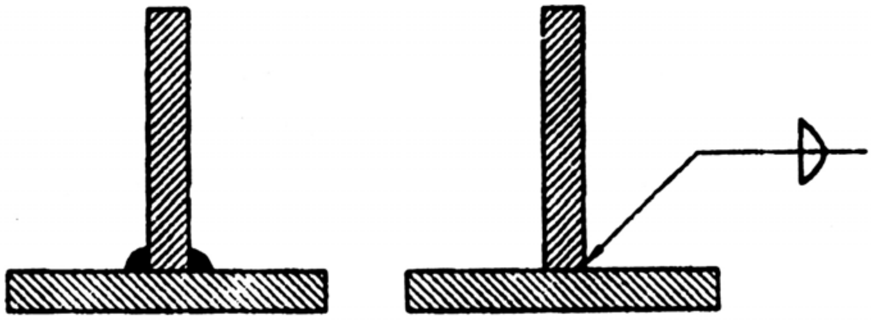
Procedure:

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned one over another for the lap joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

Result:

Thus the required lap joint is obtained as per the given dimensions.





Welded Joint Representation

3. TEE JOINT

Aim:

To make a Tee joint on the given work pieces using arc welding.

Apparatus required:

Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, Chipping hammer, Gloves and Goggles.

Procedure:

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned at right angles for the tee joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

Result:

Thus the required Tee joint is obtained as per the given dimensions.

LATHE

LATHE

The lathe is used for producing cylindrical work. The work piece is rotated while the cutting tool movement is controlled by the machine. The lathe is primarily used for cylindrical work. The lathe may also be used for: Boring, drilling, tapping, turning, facing, threading, polishing, grooving, knurling etc.

The purpose of a lathe is to rotate a part against a tool whose position it controls. It is useful for fabricating parts and/or features that have a circular cross section. The spindle is the part of the lathe that rotates. Various work holding attachments such as three jaw chucks, collets, and centers can be held in the spindle. The spindle is driven by an electric motor through a system of belt drives and/or gear trains. Spindle speed is controlled by varying the geometry of the drive train.

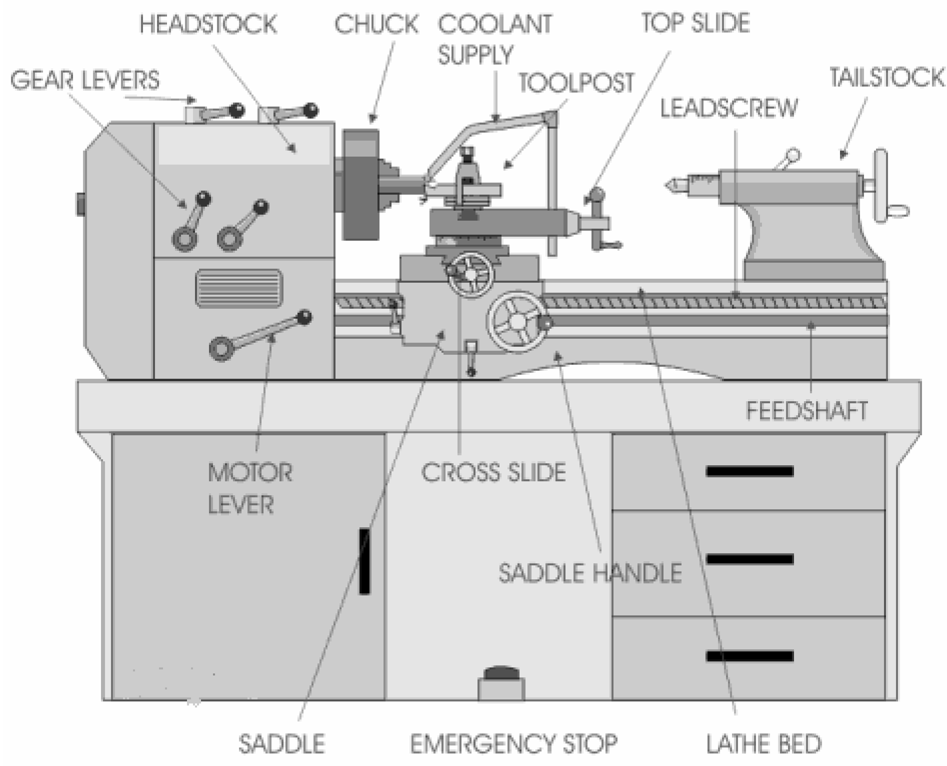
The tailstock can be used to support the end of the work piece with a center, or to hold tools for drilling, reaming, threading, or cutting tapers. It can be adjusted in position along the ways to accommodate different length work pieces. The ram can be fed along the axis of rotation with the tailstock hand wheel.

The carriage controls and supports the cutting tool. It consists of: A saddle that mates with and slides along the ways, an apron that controls the feed mechanisms, a cross slide that controls transverse motion of the tool (toward or away from the operator), a tool compound that adjusts to permit angular tool movement and a tool post T-slot that holds the tool post.

Feed, Speed, And Depth of Cut

Cutting speed is defined as the speed at which the work moves with respect to the tool. Feed rate is defined as the distance the tool travels during one revolution of the part. Cutting speed and feed determines the surface finish, power requirements, and material removal rate. The primary factor in choosing feed and speed is the material to be cut. However, one should also consider material of the tool, rigidity of the work piece, size and condition of the lathe, and depth of cut. To calculate the proper spindle speed, divide the desired cutting speed by the circumference of the work.

Parts of Lathe



Head Stock

The headstock houses the main spindle , speed change mechanism , and change gears The headstock is required to be made as robust as possible due to the cutting forces involved, which can distort a lightly built housing, and induce harmonic vibrations that will transfer through to the work piece, reducing the quality of the finished work piece

Bed

The bed is a robust base that connects to the headstock and permits the carriage and tailstock to be aligned parallel with the axis of the spindle. This is facilitated by hardened and ground ways which restrain the carriage and tailstock in a set track. The carriage travels by means of a rack and pinion system, leads crew of accurate pitch, or feed screw.

Feed and lead screws

The feed screw is a long driveshaft that allows a series of gears to drive the carriage mechanisms. These gears are located in the apron of the carriage. Both the feed screw and lead screw are driven by either the change gears or an intermediate gearbox known as a quick change gearbox or Norton gearbox. These intermediate gears allow the correct ratio and direction to be set for cutting threads or worm gears. Tumbler gears are provided between the spindle and gear train that enables the gear train of the correct ratio and direction to be introduced. This provides a constant relationship between the number of turns the spindle makes, to the number of turns the lead screw makes. This ratio allows screw threads to be cut on the work piece without the aid of a die.

Carriage

In its simplest form the carriage holds the tool bit and moves it longitudinally (turning) or perpendicularly (facing) under the control of the operator. The operator moves the carriage manually via the hand wheel or automatically by engaging the feed screw with the carriage feed mechanism, this provides some relief for the operator as the movement of the carriage becomes power assisted. The hand wheels on the carriage and its related slides are usually calibrated both for ease of use and to assist in making reproducible cuts.

Cross-slide

The cross-slide stands atop the carriage and has a lead screw that travels perpendicular to the main spindle axis, this permit facing operations to be performed. This lead screw can be engaged with the feed screw (mentioned previously) to provide automated movement to the cross-slide; only one direction can be engaged at a time as an interlock mechanism will shut out the second gear train.

Compound rest

The compound rest is the part of the machine where the tool post is mounted. It provides a smaller amount of movement along its axis via another lead screw. The compound rest axis can be adjusted independently of the carriage or cross-slide. It is utilized when turning tapers, when screw cutting or to obtain finer feeds than the lead screw normally permits.

Tool post

The tool bit is mounted in the tool post which may be of the American lantern style, traditional 4 sided square styles, or in a quick change style. The advantage of a quick change set-up is to allow an unlimited number of tools to be used (up to the number of holders available) rather than being limited to 1 tool with the lantern style, or 3 to 4 tools with the 4 sided type.

Tail Stock

The tailstock is a tool holder directly mounted on the spindle axis, opposite the headstock. The spindle does not rotate but does travel longitudinally under the action of a lead screw and hand wheel. The spindle includes a taper to hold drill bits, centers and other tooling. The tailstock can be positioned along the bed and clamped in position as required. There is also provision to offset the tailstock from the spindles axis; this is useful for turning small tapers.

Lathe Operations

Turning

Turning is the machining operation that produces cylindrical parts. In its basic form, it can be defined as the machining of an external surface:

- with the work piece rotating,
- with a single-point cutting tool, and
- with the cutting tool feeding parallel to the axis of the work piece and at a distance that will remove the outer surface of the work.

Taper turning is practically the same, except that the cutter path is at an angle to the work axis. Similarly, in contour turning, the distance of the cutter from the work axis is varied to produce the desired shape

Facing

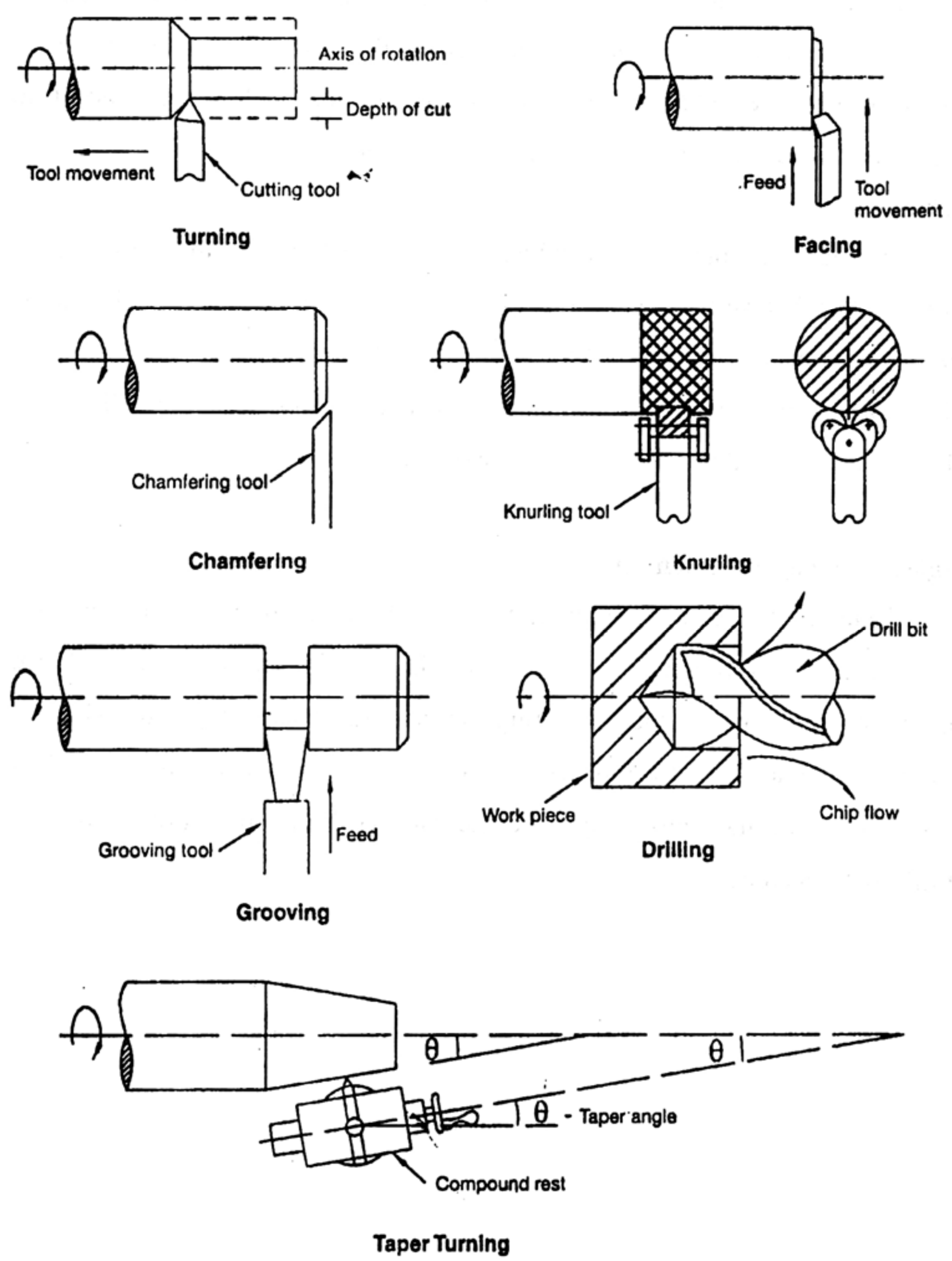
Facing is the producing of a flat surface as the result of a tool's being fed across the end of the rotating work piece. Unless the work is held on a mandrel, if both ends of the work are to be faced, it must be turned end for end after the first end is completed and the facing operation repeated. The cutting speed should be determined from the largest diameter of the surface to be faced. Facing may be done either from the outside inward or from the center outward. In either case, the point of the tool must be set exactly at the height of the center of rotation.

Parting

Parting is the operation by which one section of a work piece is severed from the remainder by means of a cutoff tool. Because cutting tools are quite thin and must have considerable overhang, this process is less accurate and more difficult. The tool should be set exactly at the height of the axis of rotation, be kept sharp, have proper clearance angles, and be fed into the work piece at a proper and uniform feed rate.

Drilling

A lathe can also be used to drill holes accurately concentric with the centerline of a cylindrical part. First, install a drill chuck into the tail stock. Make certain that the tang on the back of the drill chuck seats properly in the tail stock. Withdraw the jaws of the chuck and tap the chuck in place with a soft hammer.



Move the saddle forward to make room for the tailstock. Move the tailstock into position, and lock the bit in place. Before starting the machine, turn the spindle by hand. Just move the saddle forward, so it could interfere with the rotation of the lathe chuck. Always use a center drill to start the hole. .

Boring

Boring is an operation in which a hole is enlarged with a single point cutting tool. A boring bar is used to support the cutting tool as it extends into the hole. Because of the extension of the boring bar, the tool is supported less rigidly and is more likely to chatter. This can be corrected by using slower spindle speeds or by grinding a smaller radius on the nose of the tool.

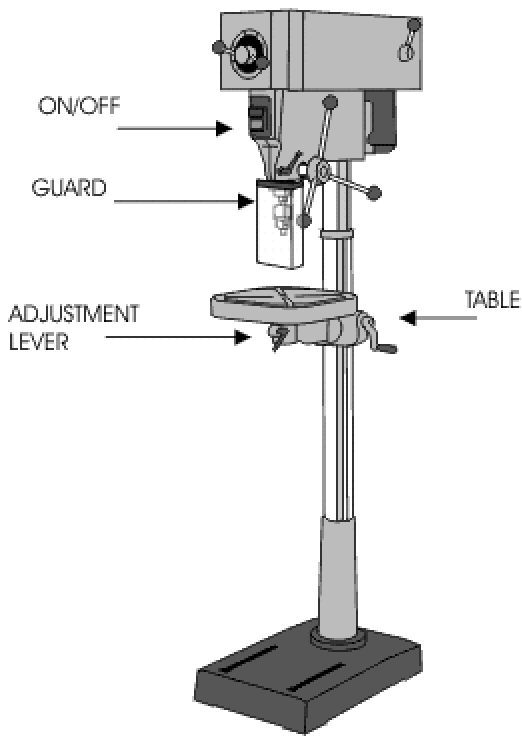
Single Point Thread Turning

External threads can be cut with a die and internal threads can be cut with a tap. But for some diameters, no die or tap is available. In these cases, threads can be cut on a lathe. A special cutting tool should be used, typically with a 60 degree nose angle. To form threads with a specified number of threads per inch, the spindle is mechanically coupled to the carriage lead screw. Procedures vary for different machines

Drilling Machine

The machine which performs the drilling operation is known as drilling machine. There are two types of machine drill, the bench drill and the pillar drill. The bench drill is used for drilling holes through materials including a range of woods, plastics and metals. It is normally bolted to a bench so that it cannot be pushed over and that larger pieces of material can be drilled safely.

The larger version of the machine drill is called the pillar drill. This has a long column which stands on the floor. This can do exactly the same work as the bench drill but because of its larger size it is capable of being used to drill larger pieces of materials and produce larger holes.



SAFETY MEASURES

1. Always use the guard.
2. Wear goggles when drilling materials.
3. Clamp the materials down or use a machine vice.

4. Never hold materials by hand while drilling.

5. Always allow the ‘chippings’ to clear the drill by drilling a small amount at a time.

6. Follow all teacher instructions carefully.

TYPES OF DRILLING MACHINE

1. Portable drilling machine
2. Sensitive drilling machine
3. Upright drilling machine
4. Radial drilling machine
5. Gang drilling machine
6. Multi spindle drilling machine

Bench Drill

The bench drill is a smaller version of the pillar drill. This type of machine drill is used for drilling light weight pieces of material. The work piece is held safely in a hand vice which is held in the hand. NEVER hold work directly in the hand when drilling. The on and off buttons are found on the left hand side of the machine and the handle controlling the movement of the drill on the right. Most bench drills will also have a foot switch for turning off the drill. The hand vice is one safe way of holding material whilst drilling. It has two jaws that are closed by turning a wing nut.

Drilling Operations

1. Drilling

It is the operation by which circular holes can be produced by rotating a tool called drill bit against the work piece. Using centre punch the centre of the hole is marked before drilling. The hole produced by drilling will be rough and of less accuracy.

2. Reaming

It is the operation of finishing and sizing the already drilled hole. The tool used is called reamer. It removes very little amount of metal to finish the hole.

3. Boring

The operation to enlarge the drilled hole is called boring. For boring, the cutter is held in a boring bar and is fixed to the spindle. It gives good surface finish.

4. Counter boring

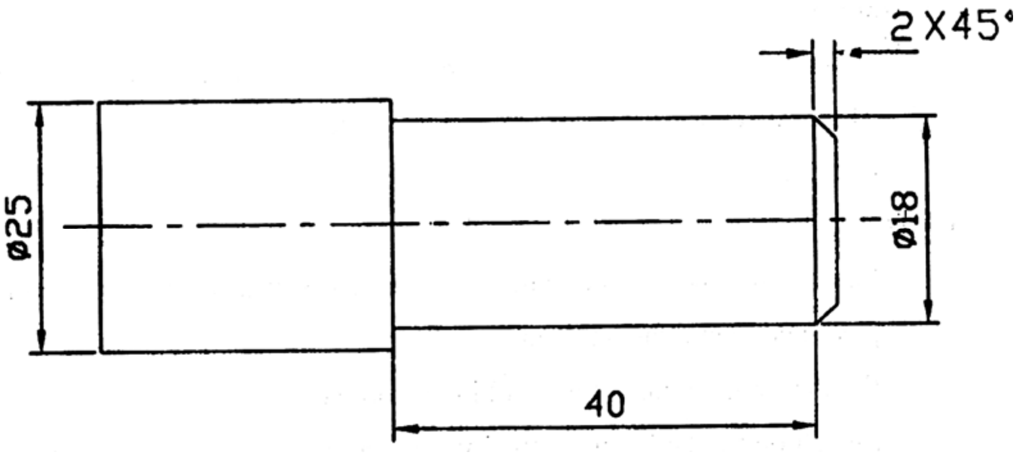
To seat the heads of socket, screw and studs, a drilled hole is enlarged to a given depth. This operation is called counter boring.

5. Counter sinking

The operation of machining a conical enlargement at the top of a drilled hole is called counter sinking.

Viva Voce Questions

1. What is the use of lathe?
2. What is feed, speed and depth of cut in lathe?
3. Name the holding device in lathe.
4. What is called live centre?
5. What is called dead centre?
6. List out various parts of a lathe.
7. What is head stock?
8. What is tail stock?
9. What is the use of carriage?
10. What is the use of cross slide?
11. What is the use of compound rest?
12. List out various lathe operations.
13. Differentiate turning from facing operation.
14. What is the use of chamfering?
15. What is the use of knurling?
16. Explain the functions of feed screw and lead screw in lathe.
17. How the drilling operation can be carried out in a lathe?
18. What is step turning and taper turning?
19. What is the use of drilling machine?
20. What are the different types of drilling machines?


2X45°
ø25
ø18
40

1. TURNING, FACING AND CHAMFERING

Aim To perform turning, facing and chamfering on a cylindrical work piece

Tools Required

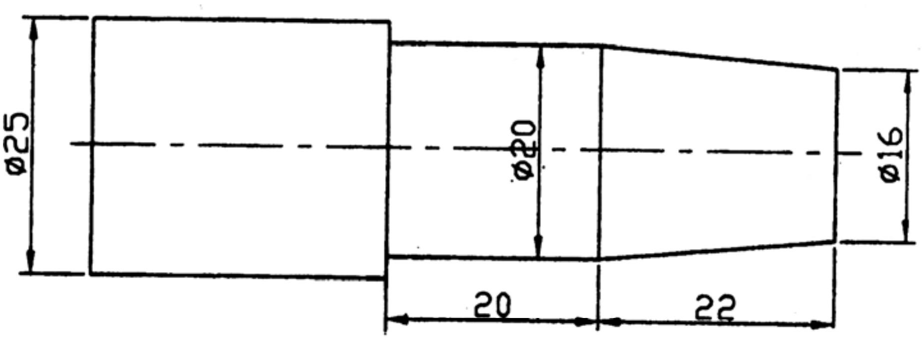
1. Lathe
2. Three jaw chuck
3. Chuck key
4. Single point cutting tool
5. Vernier caliper

Procedure

1. Loosen the jaws in the chuck using chuck key to position the work piece and then tighten the jaws.
2. Fix the single point cutting tool in the tool post
3. Switch on the lathe, move the carriage near the work piece and give a small cross feed. Move the carriage slowly to the required length
4. Bring the carriage to the original position, give a small cross feed and repeat the steps until the required diameter is obtained. At the end give very small feed to get smooth surface.
5. For facing operation, the cutting tool is tilted by 30˚ and move the carriage to make the tool touch the end surface of the work piece.
6. Give small feed in longitudinal direction and then move the tool inwards using cross slide.
7. For chamfering operation, set the cross slide to 45˚, give small feed in longitudinal direction and then move the tool using cross slide.
8. Check the dimensions regularly using vernier caliper.

Result

Thus the turning, facing and chamfering operations are carried out on the given work piece



Taper angle $\tan\theta = \frac{D-d}{2L}$

D – Larger diameter of taper

d – Smaller diameter of taper

L – Tapered length

2. TAPER TURNING

Aim

To perform taper turning operation on a cylindrical work piece

Tools Required

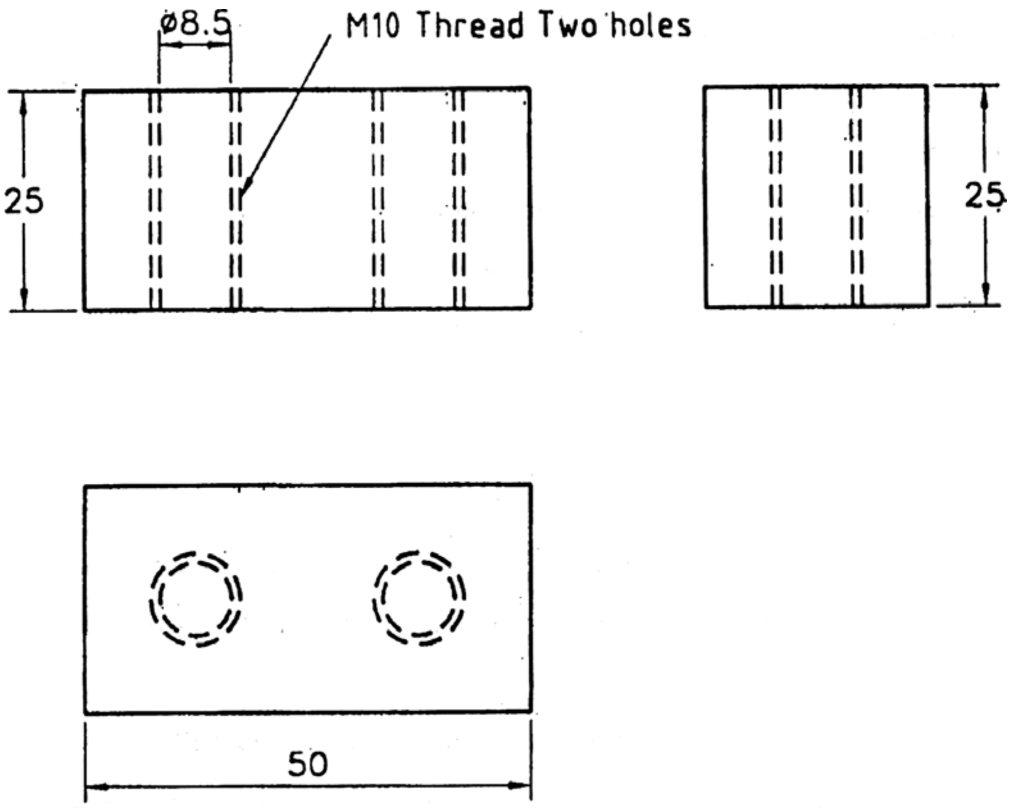
1. Lathe
2. Three jaw chuck
3. Chuck key
4. Single point cutting tool
5. Vernier caliper

Procedure

1. Loosen the jaws in the chuck using chuck key to position the work piece and then tighten the jaws.
2. Fix the single point cutting tool in the tool post
3. Switch on the lathe, move the carriage near the work piece and give a small cross feed. Move the carriage slowly to the required length
4. Bring the carriage to the original position, give a small cross feed and repeat the steps until the required diameter is obtained. At the end give very small feed to get smooth surface.
5. To produce a taper, rotate and set the cross slide to the required angle.
6. Give a small feed and then move the tool using the cross slide. Repeat the steps to complete the taper.
7. Check the dimensions regularly using vernier caliper.

Result

Thus the taper turning operation is carried out on the given work piece



Dimensions After Machining

3. DRILLING AND TAPPING

Aim:

To make an internal thread on a given work piece as per the required dimensions using drilling machine and tapping tool.

Tools Required:

1. Machine vice	2. Drilling machine
3. Drill bit	4. Tapping tool
5. Dot punch	6. Hammer etc.

Procedure:

1. The dimensions of the given work piece is checked as per the requirement.
2. The work piece is clamped in the vice and any two surfaces are filed to get right angle.
3. Drill bit of required size is fitted in the drill chuck of the drilling machine.
4. The mid point of the required hole is punched by using dot punch and hammer.
5. The punched dot is drilled by drilling machine.
6. After drilling the hole, they are tapped by using tap tool.
7. Finally the dimensions are checked.

Result:

Thus the given work piece is drilled and tapped to the required dimensions.

SHEET METAL

SHEET METAL

Introduction

Sheet metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bent into a variety of different shapes. Countless everyday objects are constructed of the material. Thicknesses can vary significantly, although extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate.

Sheet metal is available as flat pieces or as a coiled strip. The coils are formed by running a continuous sheet of metal through a roll slitter.

The thickness of the sheet metal is called its gauge. The gauge of sheet metal ranges from 30 gauge to about 8 gauge. The higher the gauge, the thinner the metal is.

There are many different metals that can be made into sheet metal, such as aluminum, brass, copper, steel, tin, nickel and titanium. For decorative uses, important sheet metals include silver, gold, and platinum (platinum sheet metal is also utilized as a catalyst.)

Sheet metal has applications in car bodies, airplane wings, medical tables, roofs for building and many other things. Sheet metal of iron and other materiales with high magnetic permeability, also known as laminated steel cores, has applications in transformers and electric machines. Historically, an important use of sheet metal was in plate armor worn by cavalry, and sheet metal continues to have many decorative uses, including in horse tack.

Sheet metal processing

The raw material for sheet metal manufacturing processes is the output of the rolling process. Typically, sheets of metal are sold as flat, rectangular sheets of standard size. If the sheets are thin and very long, they may be in the form of rolls. Therefore the first step in any sheet metal process is to cut the correct shape and sized 'blank' from larger sheet.

Sheet metal processes

Sheet metal processes can be broken down into two major classifications and one minor classification

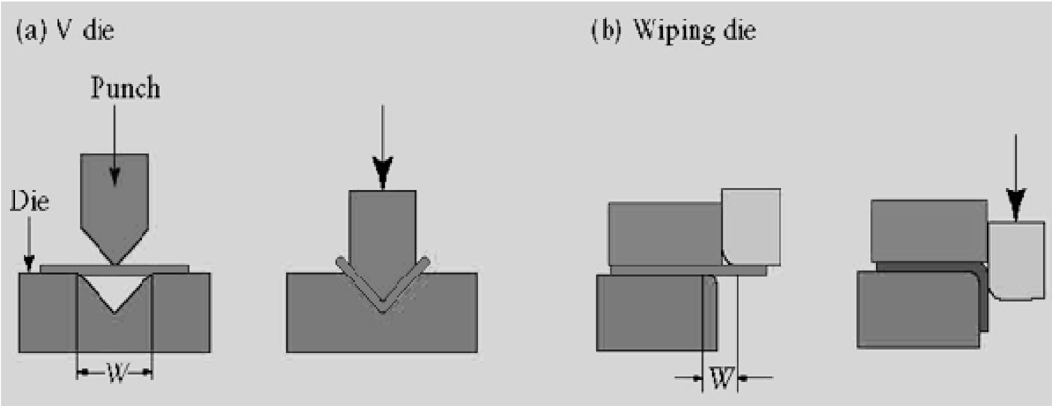
- **Shearing processes** - processes which apply shearing forces to cut, fracture, or separate the material.
- **Forming processes** - processes which cause the metal to undergo desired shape changes without failure, excessive thinning, or cracking. This includes bending and stretching.
- **Finishing processes** - processes which are used to improve the final surface characteristics.

Shearing Process

1. Punching: shearing process using a die and punch where the interior portion of the sheared sheet is to be discarded.
2. Blanking: shearing process using a die and punch where the exterior portion of the shearing operation is to be discarded.
3. Perforating: punching a number of holes in a sheet
4. Parting: shearing the sheet into two or more pieces
5. Notching: removing pieces from the edges
6. Lancing: leaving a tab without removing any material

Forming Processes

- **Bending:** forming process causes the sheet metal to undergo the desired shape change by bending without failure. Ref fig.
- **Stretching:** forming process causes the sheet metal to undergo the desired shape change by stretching without failure.
- **Drawing:** forming process causes the sheet metal to undergo the desired shape change by drawing without failure.
- **Roll forming:** Roll forming is a process by which a metal strip is progressively bent as it passes through a series of forming rolls.



Common Die – Bending operations

Finishing processes

Material properties, geometry of the starting material, and the geometry of the desired final product play important roles in determining the best process

Equipments

Basic sheet forming operations involve a press, punch, or ram and a set of dies

Presses

- **Mechanical Press** - The ram is actuated using a flywheel. Stroke motion is not uniform.
- **Hydraulic Press** - Longer strokes than mechanical presses, and develop full force throughout the stroke. Stroke motion is of uniform speed, especially adapted to deep drawing operations.

Dies and Punches

- **Simple**- single operation with a single stroke
- **Compound**- two operations with a single stroke
- **Combination**- two operations at two stations
- **Progressive**- two or more operations at two or more stations with each press stroke, creates what is called a strip development

Tools and Accessories

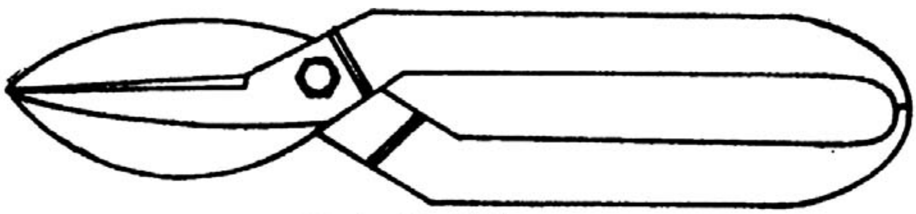
The various operations such as cutting, shearing, bending, folding etc. are performed by these tools.

Marking and measuring tools

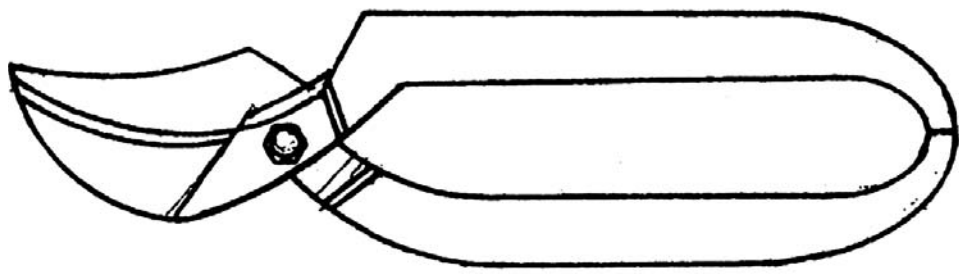
- **Steel Rule** - It is used to set out dimensions.
- **Try Square** - Try square is used for making and testing angles of 90degree
- **Scriber** – It used to scribe or mark lines on metal work pieces.
- **Divider** - This is used for marking circles, arcs, laying out perpendicular lines, bisecting lines, etc

Cutting Tools

- **Straight snip** - They have straight jaws and used for straight line cutting. Ref fig.
- **Curved snip** - They have curved blades for making circular cuts. Ref fig.



STRAIGHT SNIP

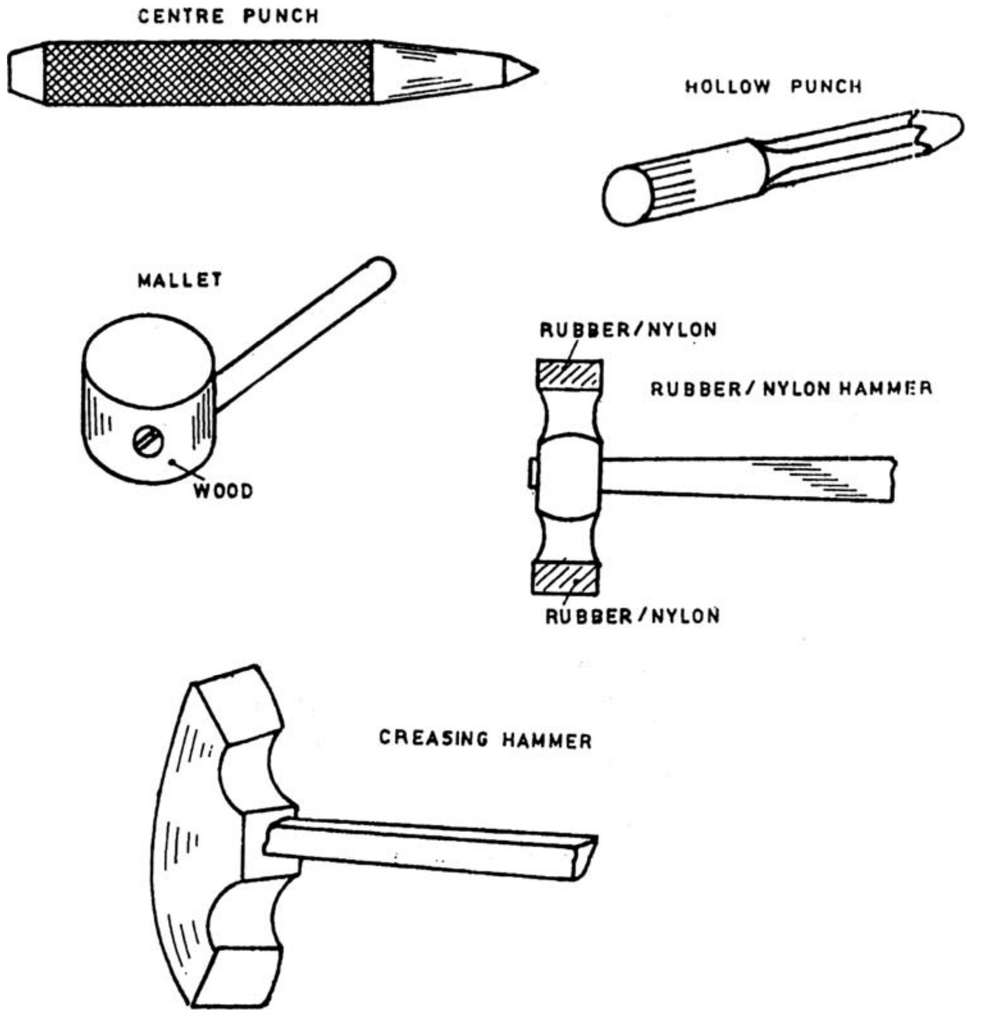


CURVED SNIP

Striking Tools

Mallet - It is wooden-headed hammer of round or rectangular cross section. The striking face is made flat to the work. A mallet is used to give light blows to the Sheet metal in bending and finishing. Ref fig.

Hammers – Hammers are also used in sheet metal work for forming shapes. Commonly used hammers are rubber / nylon hammers and creasing hammer.



Merits

High strength

Good dimensional accuracy and surface finish

Relatively low cost

Demerits

Wrinkling and tearing are typical limits to drawing operations

Different techniques can be used to overcome these limitations

- Draw beads
- Vertical projections and matching grooves in the die and blank holder

Trimming may be used to reach final dimensions

Applications

Roofings

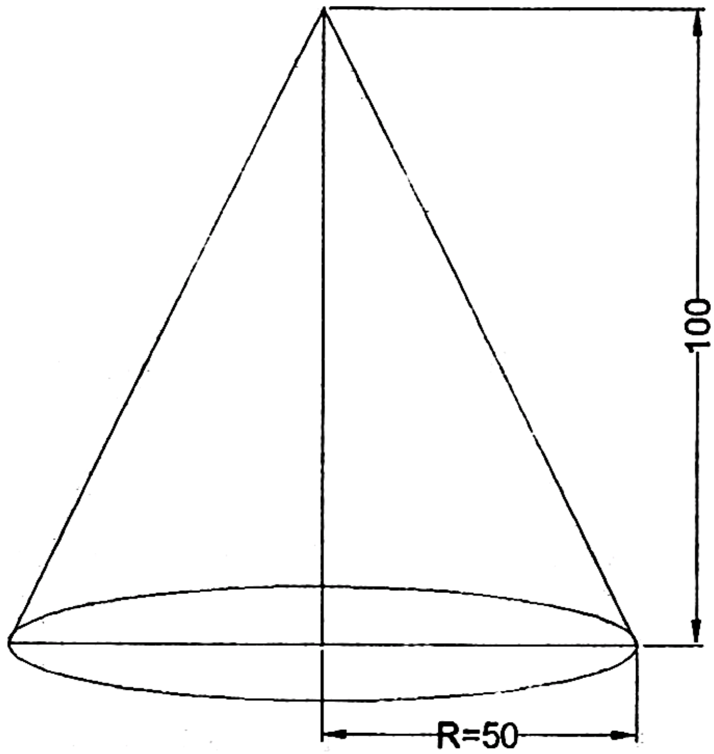
Ductings

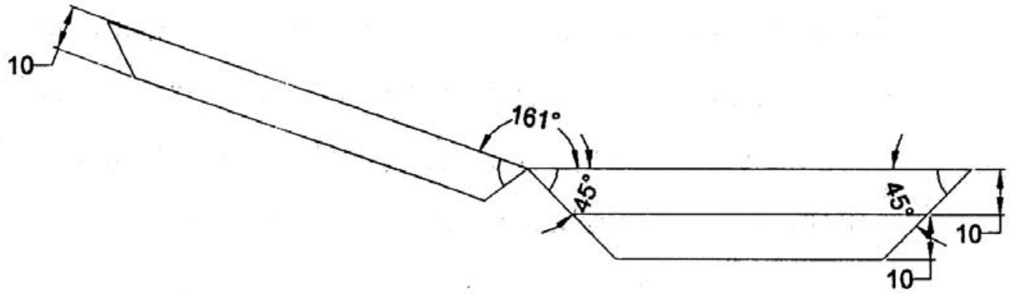
Vehicles body buildings like 3 wheelers, 4 wheelers, ships, aircrafts etc.

Furnitures, House hold articles and Railway equipment

Viva Voce Questions

1. What is sheet metal work?
2. Write down any four sheet metal characteristics
3. What is meant by clearance?
4. What is stretching?
5. Define the term "spring back"
6. How force exerted on the form block is calculated
7. What are the formability test methods?
8. What is super plasticity of metals?
9. What is metal spinning process?
10. What is sheet metal?


100
R=50


10
161°
45°
45°
10
10

1. CONE MAKING

Aim: To make a hollow cone out of the given sheet with specified dimensions.

Tools required:

1. Sheet metal 2. anvil 3. Try square 4. Steel rule

5. Divider 6. Snip 7. Scriber

8. Mallet 9. File 10. Hand shearing machine

11. Protractor etc.

Materials required:

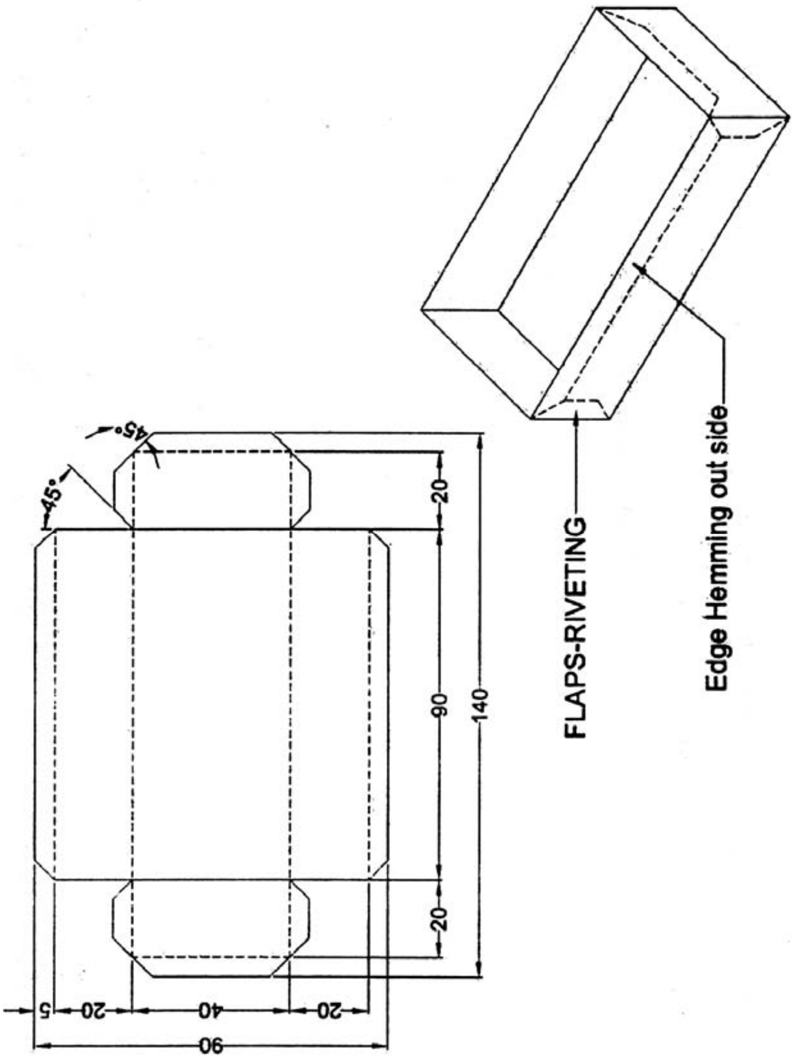
Tin or mild steel of suitable size.

Procedure:

1. Development of cone for the given dimensions is drawn on the provided sheet metal using protractor and scriber. (Sector of radius equal to the slant length of the cone and arc length equal to the circumference of the cone)
2. Assume, joining allowance of 10 to 15mm on either side of the development.
3. The sheet metal is exactly cut as per the markings made on it using a straight shear / snip. The burrs are removed using a file.
4. Then the edges are bent for a length of joining allowance. This is done with the help of a mallet and an appropriate stake / anvil.
5. The sheet metal is then formed to the conical shape using a cylindrical stake / anvil and a mallet as shown in fig.
6. Now the bent edges are made to over lap each other and are struck with a mallet to get the required joint.

Result:

Thus the cone of given dimension is fabricated with the given sheet metal.


FLAPS-RIVETING
Edge Hemming out side
45°
45°
20
90
20
140
5
20
40
20
90

2. TRAY MAKING

Aim: To make a rectangular tray out of the given sheet with specified dimensions.

Tools required:

1. Sheet metal 2. anvil 3. Try square 4. Steel rule

5. Divider 6. Snip 7. Scriber

8. Mallet 9. File 10. Hand shearing machine

11. Protractor etc.

Materials required:

Tin or mild steel of suitable size.

Procedure:

1. Development of the rectangular tray for the given dimensions is drawn on the provided sheet metal using steel rule, protractor and scriber as shown in fig.
2. Assume some joining allowance on all sides of the development for locking the tray.
3. The sheet metal is exactly cut as per the markings made on it using a hand shearing machine or snip. The burrs are removed using a file.
4. Single hemming is made on the four sides of the tray as shown in fig.
5. Four sides are bent to 90° using stake / anvil.
6. Then the edges are bent for the length of joining allowance and the edges are made to over lap each other and are struck with a mallet to get the required joint.

Result:

Thus the rectangular tray of given dimension is fabricated with the given sheet metal.

EX. NO. 1 MACHINING A WORKPIECE BY BORING AND INTERNAL THREAD CUTTING OPERATIONS USING LATHE

Aim:

To perform the boring and internal thread cutting operations on the given work piece as per the given dimensions.

Material Required:

- Mild steel rod

Tools Required:

- Lathe
- Scriber
- Steel rule
- Vernier caliper
- Cutting tool
- Chuck key
- Tool post key
- Internal thread cutting tool

Procedure:

1. The dimension of the given work piece are checked by vernier caliper.

2. The work piece is held in the lathe chuck properly and it is tightened by chuck key.

3. The cutting tool is set in a tool post such that the point of the cutting tool coincides with the lathe axis.

4. The machine is switched ON to remove the work piece at the selected speed.

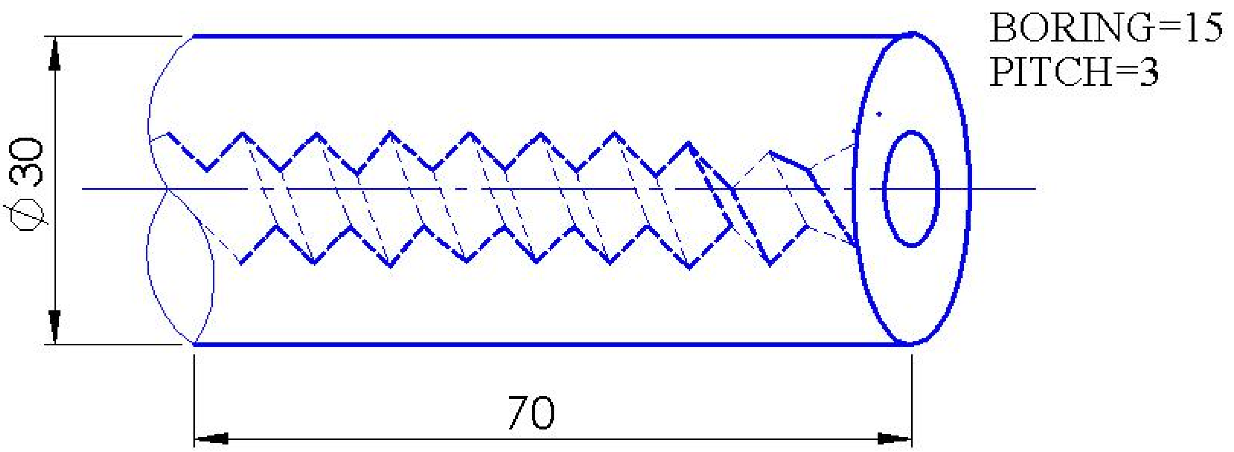
5. By the giving cross feed and longitudinal feed to the cutting tool the facing and turning operations are done respectively.

6. The speed of the work piece is reduced.

7. The external thread cutting operation is done by using external V thread cutting tool by engaging thread cutting mechanism.

8. The work piece is removed from the chuck and all the dimensions are measured and checked.

BORING AND INTERNAL THREAD CUTTING OPERATIONS



ALL DIMENSIONS ARE IN MM

Calculate Time for Boring

Calculate Time for Threading

Gearing ratio= Driver teeth/Driven teeth=TPI to be cut /TPI on lead screw (inch)

Gear ratio= Driver teeth/Driven teeth= **5Pn/127(**metric)

Depth of cut = 0.6403Xpitch

Pitch=1/No of TPI

Result: Thus the required size and shape of the given work piece is obtained

Valliammai Engineering College

SRM Nagar, Kattankulathur - 603203

Department of Electrical and Electronics Engineering

GE6162 – ENGINEERING PRACTICES LABORATORY

ELECTRICAL

LAB MANUAL

I Year- I Semester

Academic Year 2015-2016

(2013Regulation)

GROUP B (ELECTRICAL)

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. Fluorescent lamp wiring.

3.Stair case wiring

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

5. Measurement of energy using single phase energy meter.

6. Measurement of resistance to earth of electrical equipment.

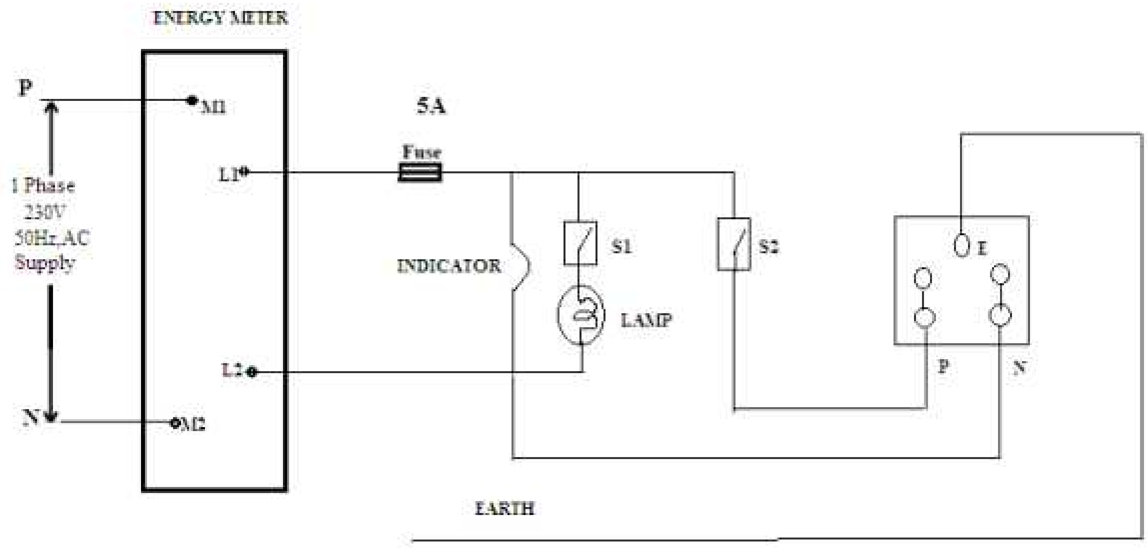
Beyond the syllabus experiment

1. Different types of joints for making wiring
2. Characteristics of digital multimeter
3. Assembling a transformer
4. Bright and Dim lamp method

INDEX

S.No	Date	Name of the Experiment	Page No.	Marks(10)	Staff Sign

CIRCUIT DIAGRAM:



EX.NO:
DATE:

RESIDENTIAL HOUSE WIRING USING SWITCHES, FUSE, INDICATOR, LAMP AND ENERGY METER

AIM:

To Construct House wiring using switches, fuse, indicator, lamp and Energy Meter.

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Single way Switch	5A	1
2	Fuse	5A	1
3	Indicator	5A	1
4	Incandescent Lamp	60 W	1
5	Energy meter	300V,5A	1
6	Connecting wires	1/18 SWG	As per requirement

THEORY:

Conductors, switches and other accessories should be of proper capable of carrying the maximum current which will flow through them. The following table shows the rating for different accessories. Conductors should be of copper or aluminum. In power circuit, wiring should be designed for the load which it is supposed to carry. Power sub circuits should be kept separate from lighting and fan sub – circuits. Wiring should be done on the distribution system with main and branch distribution boards at convenient centers. Wiring should neat, with good appearance.

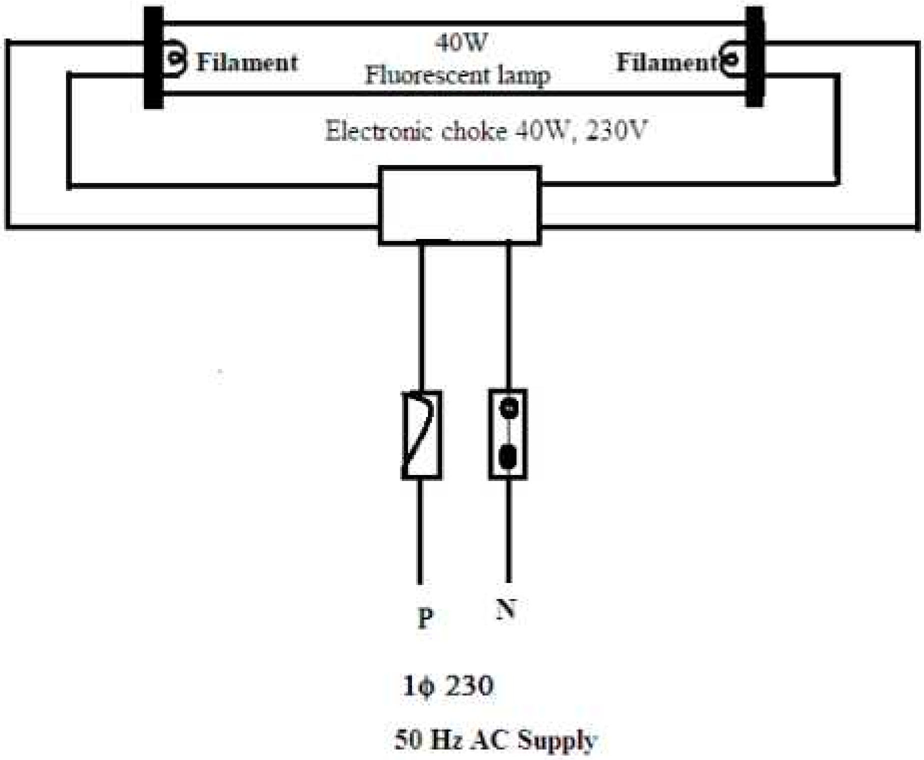
- Wires should pass through a pipe or box, and should not twist or cross.
- The conductor is carried in a rigid steel conduit conforming to standards or in a porcelain tube.

PROCEDURE:

1. Study the given wiring diagram.
2. Make the location points for energy meter, fuse, indicator, main switch box, Switch board, lamp and ceiling rose.
3. Draw the lines for wiring on the wooden board.
4. Place the wires along with the line and fix.
5. Fix the bulb holder, Switches, Ceiling rose, Socket in marked positions on the wooden board.
6. Connect the energy meter and main switch box in marked positions on the wooden board.
7. Give a supply to the wires circuit.
8. Test the working of light and socket.

RESULT:

CIRCUIT DIAGRAM:



EX.NO:
DATE:

FLUORESCENT LAMP WIRING

AIM:

To make and check the fluorescent lamp wiring.

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Fluorescent Lamp	40W	1 Set
2	Connecting wires	1/18 SWG	As per requirement

THEORY:

Tube-lights, which are basically fluorescent, are the most commonly used high source for illumination in houses, industries, commercial organizations and public utility services. A fluorescent lamp is a low pressure mercury and public utility services. A fluorescent discharge lamp with internal surface coated with suitable fluorescent material. This lamp consists of glass tube provided at both ends with caps having two pins and oxide coated tungsten filament. Tube contains argon or krypton gas to facilitate starting with small quantity of mercury under low pressure. Fluorescent material, when subjected to electro-magnetic radiations of particular wavelength produced by the discharge through the mercury vapor, gets excited and in turn gives out radiation at some other wave length which falls under visible spectrum. Thus, the secondary radiations from fluorescent powder increase the efficiency of the lamp. Tube lights in India are generally made either 61cm long 20 W rating or 122 cm ling 40 W rating.

In order to make a tube light self starting, electronic choke is connected in the circuit. When switch S is closed, full supply voltage appears across the electrodes which are enclosed in a glasses bulb filled with argon gas. This voltage causes discharge in the argon gas with consequent heating of the electrodes. Due to this heating, the electrode in the starter which is made of bimetallic strip, bends and closes contact of the starter. At this stage, the choke, the filaments of the tube and the starter become connected in series across the supply. A current flows through the filaments and heats them. Meanwhile the argon discharge in the starter tube disappears and after a cooling time, the electrodes of starter cause a sudden break in the circuit. This causes a high value of induced EMF in the choke.

The induces EMF in the choke is applied across the tube light electrodes and is responsible for initiating a gaseous discharge because initial heating has already created good number of free electrons in the vicinity of electrodes. Thus, the tube light starts giving high output. Once the discharge through the tube is established, a much lower voltage than the supply voltage is required to maintain it. A reduction in voltage available drop across the choke. Power factor of the lamp is somewhat low and is about 0.5 lagging due to the inclusion of the electronic choke. A condenser, if connected across the supply, may improve the P.F to about 0.95 lagging. The light output of the lamp is a function of its supply voltage. At reduced supply voltages, the lamp may click a start but may fail to hold because of non availability of required holding voltages across the tube. Higher than normal voltage reduces the useful life of the tube light to a very great extent.

1. CHECKING OF CHOKE(ELECTRONIC CHOKE):

1. Check the chock for it's short and open with a test lamp as shown in the fig. And record the results and compare with the following table.

S. No	State of the Lamp Glow	Condition of Choke
1	Normal Glow	Internal Short circuit in choke
2	Dim	Good Working condition of chock
3	No Glow	Open circuit in the choke

2. CHECKING OF FILAMENT:

1. To test the filament on both sides of the fluorescent tube for it's continuity, make the connections as per the circuit. If the tube is in good condition, the lamp will glow normally. If the filament is not glowing the tube is burn off.
2. Discard the fluorescent tube, if there is open or fused filament in either side of the tube.

3. ASSEMBLING OF FLUORESCENT TUBE:

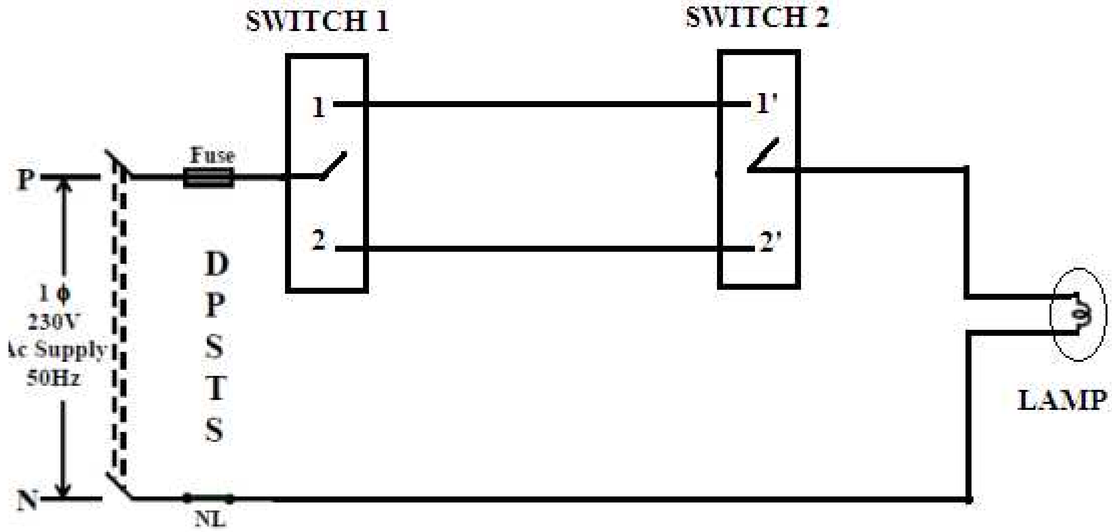
1. Assemble the fluorescent tube accessories like starter holder, holder for tube and chock in the fitting base with the help of screws.
2. Finally it is fixed in the tube holder to light it and switch ON the supply the lamp will glow.

PROCUDURE

1. Make connections as shown in the Figure.
2. Switch on the supply and adjust voltage to 230V. The tube light should start glowing.
3. Switch off the supply

RESULT:

CIRCUIT DIAGRAM:



SWITCH POSITION:

SWITCH 1	SWITCH 2	LAMP POSITION
1	1’	ON
1	2’	OFF
2	2’	ON
2	1’	OFF

EX.NO:
DATE:

STAIRCASE WIRING

AIM:

To control the status of the given lamp by using 2 two – way switches

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Two way Switch	5A	2
2	Incandescent Lamp	60 W	1
3	Connecting wires	1/18 SWG	As per requirement

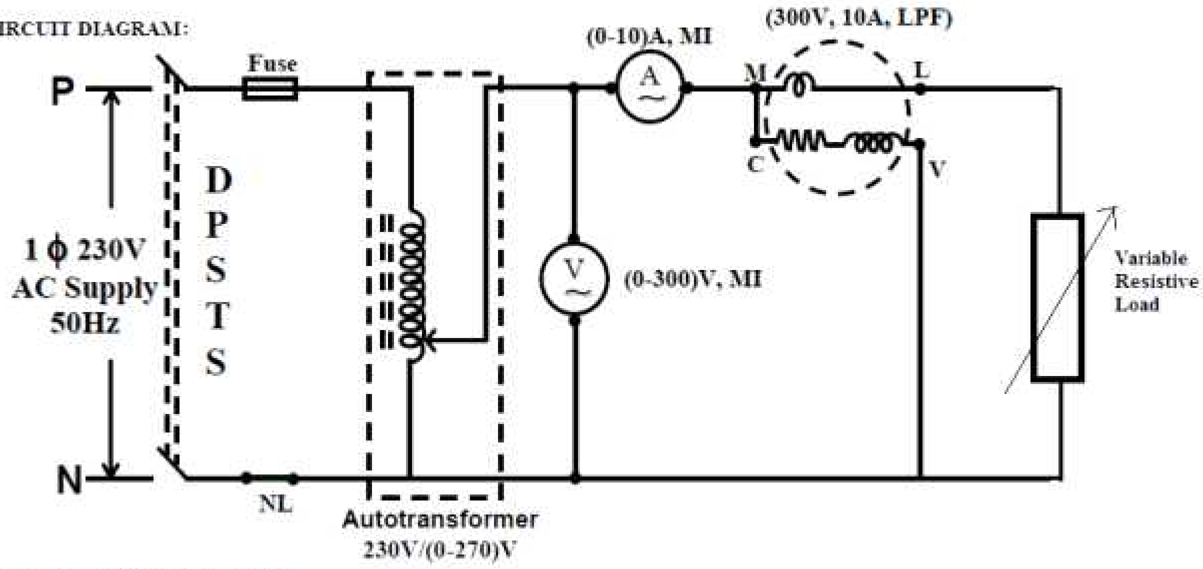
PROCEDURE:

1. Place the accessories on the wiring board as per the circuit diagram.
2. Place the P.V.C pipe and insert two wires into the P.V.C pipe.
3. Take one wire connect one end to the phase side and other end to the middle point of SPDT switch 1
4. Upper point of SPDT switch 1 is connected to the upper point of SPDT switch2.
5. Lower point of SPDT 1 is connected to the lower point SPDT switch2.
6. Another wire taken through a P.V.C pipe and middle point of SPDT switch 2 is connected to one end of the lamp holder.
7. Another end of lamp holder is connected to neutral line.
8. Screw the accessories on the board and switch on the supply.
9. Circuit is tested for all possible combination of switch position.

RESULT:

Thus the staircase wiring was done using two way switch.

CIRCUIT DIAGRAM:



OBSERVATION TABLE:

Multiplication Factor=

Sl.No	Voltage V (V)	Current I (A)	Wattmeter Reading (watts)		APPARANT POWER (watts) V*I	Power Factor cosϕ APP/ACT
			Observed	Actual		

EX.NO:
DATE:

MEASURMENT OF VOLTAGE, CURRENT, POWER AND POWER FACTOR USING RLC LOAD

AIM:

To measure power in a single phase AC circuit using wattmeter by RLC load.

APPARTUS REQUIRED:

S.no	Name of the apparatus	Range/type	Quantity
1.	Voltmeter	(0-300V) MI	1 no.
2.	Ammeter	(0-10A) MI	1 no.
3.	Wattmeter	300V,10A,LPF	1 no.
4.	RLC Load	5KW	1 no.
5.	Connecting Wires	1/18 SWG	As per requirements

THEORY:

Power in an electric circuit can be measured using a wattmeter. A wattmeter consists of two coils, namely current coil and pressure coil or potential coil. The current coil is marked as ML and pressure coil is marked as CV. The current coil measure the quantity that is proportional to the current in the circuit the pressure coil measures quantity that is proportional to the voltage in the circuit. The given wattmeter is loaded by direct loading. The ammeter is connected in series to the wattmeter. Since the same current flows in both the coils, the current and voltage across the circuit are constant. The power consumed by the load is measured using the wattmeter and calculated using the formula.

FORMULAE:

Actual power = W x Multiplication factor
Where W – Observed wattmeter reading
Apparent power = VI watts
Where V – Voltmeter reading
I – Ammeter reading
Power Factor cos ϕ = Actual Power / Apparent Power

PROCEDURE:

1. Connection is given as per circuit diagram.
2. Initially no load is applied.
3. Autotransformer is set to minimum voltage position before switching of the power supply.
4. Set the rated voltage by using the autotransformer. Measure and record the values of

voltmeter, ammeter and wattmeter on no load condition. Also carefully note the multiplication factor of the wattmeter that is mentioned in the wattmeter itself.

5. Apply the load by adjusting RLC load.

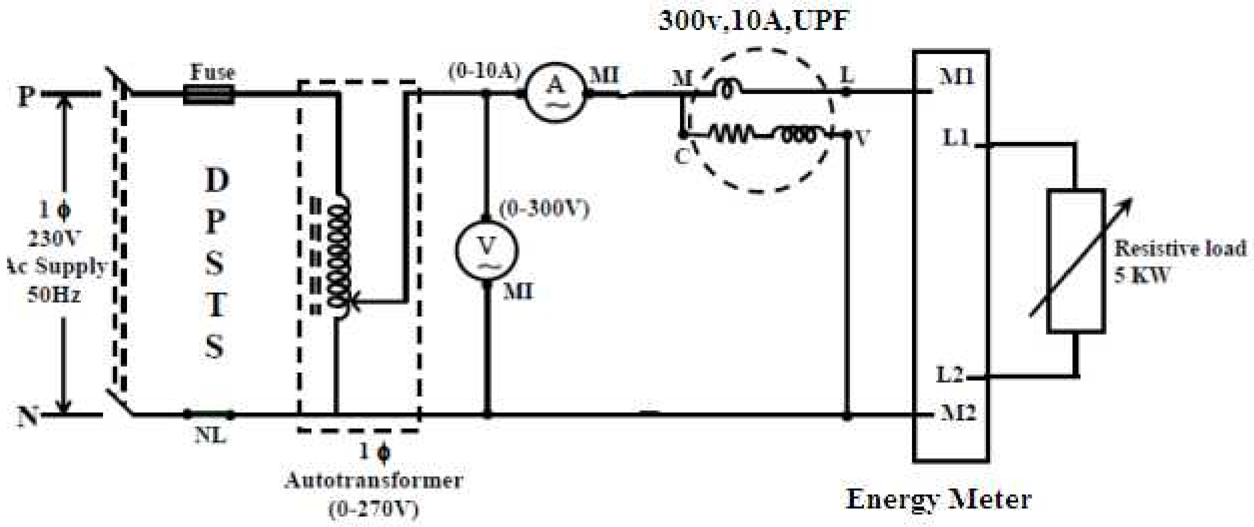
MODEL CALCULATION:

6. Measure and record the values of voltmeter, ammeter and wattmeter.
7. Repeat the steps 5 and 6 until the ammeter reading reaches 10A.
8. After taking all the readings, reduce the load slowly to the minimum and bring the voltage to minimum in the autotransformer. Switch off the power supply.
9. Calculate the power factor and power by the given formula.

RESULT:

Thus the power was calculated using wattmeter by RLC load.

CIRCUIT DIAGRAM



EX.NO:
DATE:

MEASURMENT OF ENERGY USING ENERGYMETER

AIM:

To measure the energy in a single in a phase circuit using direct Loading.

APPARTUS REQUIRED:

S.no	Name of the apparatus	Range/type	Quantity
1.	Single Phase Energymeter	600rev/Kwh	1 no.
2.	Voltmeter	(0-300V) MI	1 no.
3.	Ammeter	(0-10A) MI	1 no.
4.	Wattmeter	300V,10A,LPF	1 no.
5.	RLC Load	5KW	1 no.
6.	Connecting Wires	1/18 SWG	As per requirements

THEORY:

Energy meters are integrating instruments and are used for measurement of energy in a circuit over a given time. Since the working principle of such instrument is based on electro-magnetic induction, these are known as induction type energy meter. There are two coils in an induction type energy meter, namely current coil and voltage coil. The current coil is connected in series with the load while the voltage coil is connected across the load. The aluminium disc experiences deflecting torque due to eddy currents induced in it and its rotations are counted by a gear train mechanism. S1 and S2 are the main supply terminals and L1 and L2 are the load terminals.

The ratings associated with the energy meter are.

- Voltage rating
- Current rating
- Frequency rating
- Meter Constant

TABULAR COLUMN:

S. No	Voltmeter reading in volts	Ammeter Reading in Amps	Wattmeter reading in Watts		Time taken for 5 revolutions	True Energy in KWh	Measured energy in KWh	% Error
			Obs	Act				

MODEL CALCULATION:

FORMULAE:

Energy meter specification = 1500 rev / kWh
True energy = Power (P) x time (s)
= P x t (ws)
= P x t / 3600 x 1000 k
Measured energy = n / 1500 kWh
Where n - number of revolutions / sec
% Error = (Measured energy- True energy / True energy) x100

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Supply is given to the switch by closing the DPST switch.
3. By adjusting the voltage is brought to the rated voltage.
4. Load is switched on.
5. Time taken for five revolutions in the energy meter is noted and the Corresponding ammeter and voltmeter reading are noted.
6. The above procedure is repeated for different load current and for fixed number of revolutions.
7. Then the load is gradually released and supply is switched OFF.
8. The error is calculated and the graph is plotted between true energy and Percentage of error.

`

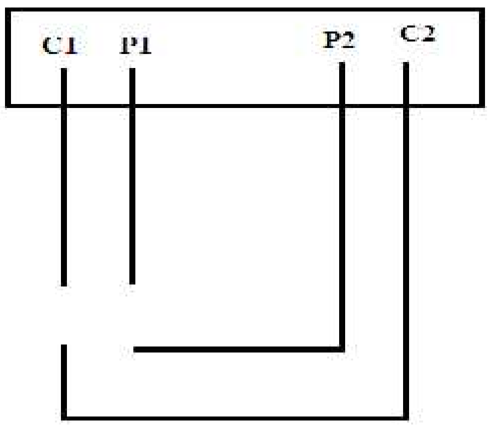
RESULT:

Thus the energy using single phase energy meter was measured.

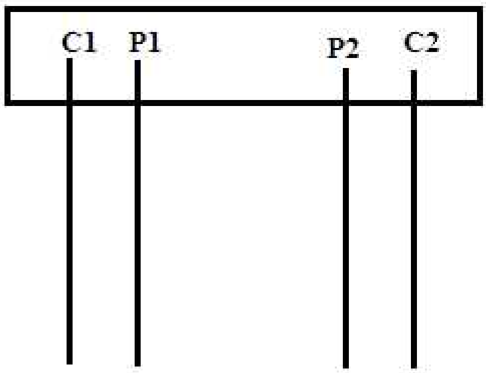
CIRCUIT DIAGRAM:

MEGGER

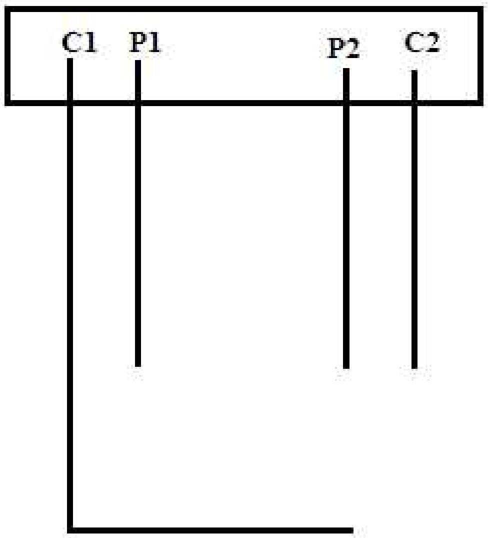
SQUARE POSITION



HORIZONTAL POSITION



TRIANGULAR POSITION



TABULATION:

S.NO	Position	Resistance ( )
1	Square	
2	Horizontal	
3	Triangular	
4		
5		

EX.NO:
DATE:

MEASUREMENT OF RESISTANCE TO EARTH OF ELECTRICAL EQUIPMENT

AIM:

To measure the resistance to earth / insulation resistance of the order of mega ohms.

THEORY:

For this experiment we have to use the Megger. It is an instrument for testing the insulation resistance of the order of mega ohms.

PRINCIPLE:

A megger consists of an emf source and a voltmeter. The voltmeter scale is calibrated in ohms. In measurement, the emf of the self-contained source should be equal that of the source used in calibration. The deflection of the moving system depends on the ratio of the currents in the coils and is independent of the applied voltage. The value of unknown resistance can be found directly from the scale of the instrument. Figure shows detailed diagram of a megger. It consists of a hand driven dc generator a emf about 500V.the permanent dc meter has two moving coils. First one is deflecting coil and another one is controlling coil. The deflecting coil is connected to the generator through a resistor R2. The torque due to the two coils opposes each other. It consists of three terminals E (earth terminal) and L (line terminal) and G (guard wire terminal).

OPERATION:

When the terminals are open circuited, no current flows through the deflecting coil. The torque to the controlling coil moves the pointer to one end of the scale. When the terminals are short circuited, the torque due to the controlling coil and the pointer is deflected to the other end of the scale i.e. zero mark. In between the two extreme positions the scale is calibrated to indicate the value of unknown resistance directly. The unknown insulation resistance is the combination of insulation volume resistance and surface leakage resistance. The guard wire terminal makes the surface leakage current to bypass the instrument hence only insulation resistance is measured.

RESULT:

Thus the earth resistance in

Horizontal position =
Square position =
Triangular position =

EX.NO:
DATE:

DIFFERENT TYPES OF JOINTS FOR MAKING WIRING

AIM:

To study the different types of electrical joints

APPARTUS REQUIRED:

S.No	Name of the apparatus	Range/type	Quantity
1	Connecting wire	1/18 SWG	As per requirement
2	Wire cutter	-	1
3	battery in battery holder with metal tags	1.5 V	1
4	Soldering iron and stand	-	1
5	Rosin-free flux cored solder	-	As per requirement
6	Voltmeter	(0-100V)	1

THEORY:

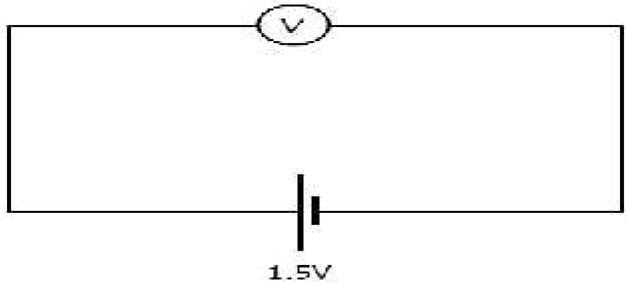
Electrical joints are the joints that connect the various components in an electrical circuit. They can be permanent (soldered or crimped), or temporary (bolted, clamped or plugged in). One of the most common permanent joints is solder. Soldering uses tin alloy solder, which has a low melting temperature. This is melted using a soldering iron and coated on the two components being joined.

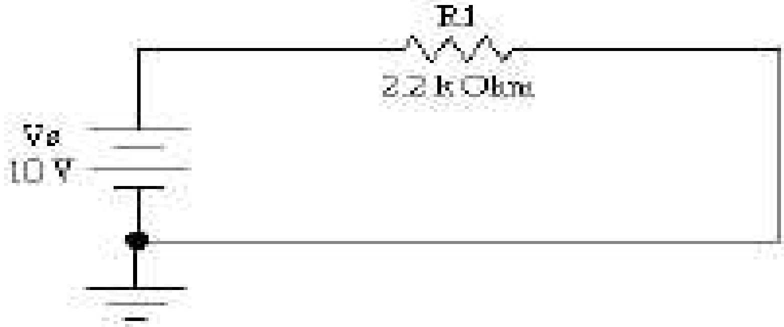
PROCEDURE:

1. Use a pair of wire strippers to take 1 cm of insulation off the end of each lead.
2. Turn the soldering iron on and wait for it to get hot.
3. When the iron is hot, clean the bit using the wet sponge. Make sure its surface is coated with a thin film of fresh solder by carefully touching some solder.
4. Touch the iron against one of the tags on the battery holder so it warms up. At the same time touch some solder against the tag so it melts and produces a thin layer of solder on the tag.
5. Do the same for the bared end of the lead (this process is sometimes called tinning).
6. Touch the soldering iron against the tag and, at the same time, bring the bare end of the lead into contact with the tag.
7. Remove the bit as soon as there is a layer of molten solder joining the wire to the tag.
8. Be careful not to move the joint while it cools down.
9. A good solder joint is shiny. If it's rough, touch the bit of the iron to the tag and add some solder until you get a better joint.
10. Clean the bit of the soldering iron on the wet sponge and repeat with the other tag and lead.
11. To check the soldered joints are working, connect the plug sockets to the voltmeter (see circuit diagram) and check the voltage across the battery.

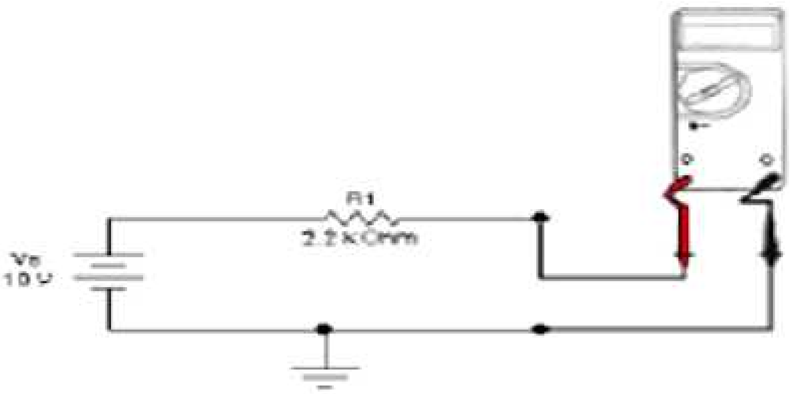
RESULT:

CIRCUIT DIAGRAM:





(A)



(B)

EX.NO:
DATE:

CHARACTERISTICS OF DIGITAL MULTIMETER

AIM:

i. To measure the resistance of a resistor using a digital multimeter
ii. To measure the DC voltage using a digital multimeter
iii. To measure the current in an electrical circuit using a digital multimeter

APPARATUS REQUIRED

S.no	Name of the apparatus	Range/type	Quantity
1	Digital multimeter with probes	-	1
2	Resistor	6.8 ,100 , 2.2K , 33K , 270 , 1M , 1K	1
3	Regulated power supply	(0-30V)	1
4	Bread board	-	1
5	Voltmeter	(0-30V) MI	1

THEORY:

A digital multimeter is an instrument which is used for measuring various electrical quantities like DC voltage, AC voltage, DC current, AC current and resistance. In **digital multimeters** the measurement result is given in numerical form. The most important component in it is an analog-to-digital (A/D) converter, which converts the measured (or from it electronically formed) DC voltage into numerical presentation.

In addition to the usual multimeter functions, microprocessor technology has enabled some new features in digital multimeters. Readout holding 'freezes' the displayed value instantly after the probe touches the measurement point; thus the user may concentrate on aligning the testing wires to the measured object. Short-circuit testing beeps when the resistance is below a certain limit. A multimeter with recording of minimum and maximum values can be left to record minimum- maximum values on its own, no matter whether they are voltages, currents, resistances or temperatures. Peak value holding is useful, when the measured circuit has voltage transients or impulse currents of less than one period's length. The use of offset makes it possible to record a signal value into the meter's memory and adding this value to or subtracting it from the following values; in this way two different voltages can be compared quickly. When offset is used together with dB-function, the dB-values can be read directly on the meter. Offset can also be used for the compensation of the measurement error caused by the resistance of the measurement leads. Many multimeters can also measure frequency. Many meters select the measurement range automatically.

i. Measurement of resistance using a digital multimeter

TABULAR COLUMN:

S.No	**Nominal value**	**Ohmmeter reading**	**Percentage difference**
1	6.8		
2	100		
3	2.2K		
4	33K		
5	270		
6	1M		
7	1K		

ii. Measurement of DC voltage using a digital multimeter

TABULAR COLUMN:

S.No	Power supply voltage	Digital multimeter reading
1	0.5	
2	2	
3	5	
4	15	
5	30	

PROCEDURE:

1. Connect the resistor into the bread broad
2. Connect the Black Probe to the COM terminal and Red Probe to the terminal marked with " ."
3. Set the meter to " ."
4. Connect the Black Probe to one end of the resistor , now connect the Red Probe to the other end of the resistor
5. Set the meter to " " function
6. Now that the meter has given a reading
7. compare the difference between the measured resistance and the nominal resistance
8. The percentage difference is calculated by:

$$Percentage\_Error := \frac{Nominal\_Value - Measured\_Value}{Nominal\_Value} \cdot 100$$

9. Note the readings and find the value of resistance.

PROCEDURE:

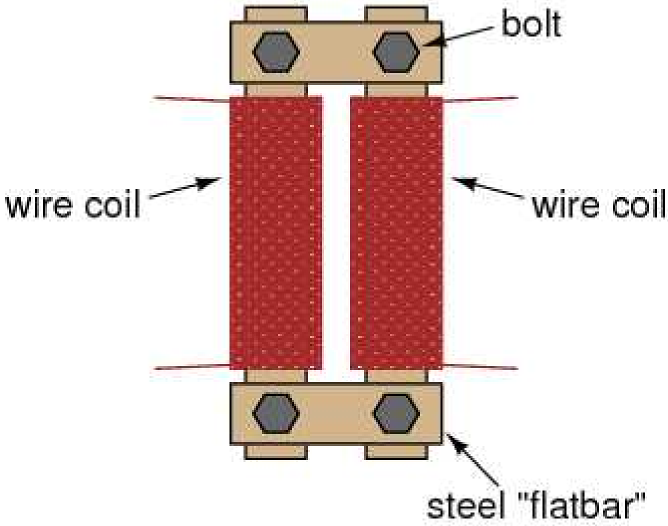
1. The voltmeter is placed in parallel with the circuit element whose voltage is to be measured
2. Locate the voltage adjustment knob, current adjustment knob, and the power switch on the power supply
3. Before you turn on the power supply rotate both the current and voltage adjustment knobs to the left.
4. Turn on the power supply and Note that both readings of current and voltage are at zero.
5. Now rotate the current knob about half way and set the voltage adjustment knob for a reading of 0.5 V.
6. Take the Digital multimeter and connect the Black Probe to the COM terminal on the meter and Red Probe to the terminal marked with "V" on the meter.
7. Set the meter to V---- function.
8. The Red Probe is connected to the positive (+) voltage terminal of the power supply and the Black Probe to the negative (-) voltage terminal of the power supply.
9. Set the power supply to the following voltages as stated in the Tabular column above and record the data's.

iii. <u>Measurement of current in an electrical circuit using a digital multimeter</u>

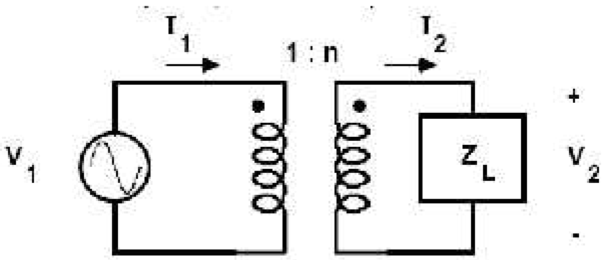
PROCEDURE:

1. Construct the circuit shown in the circuit diagram (A)
2. Set the digital multimeter selector switch to A--.
3. Connect the Black Probe to the COM terminal of the digital multimeter and the Red Probe to the digital multimeter terminal marked 300mA.
4. Insert the meter as shown in circuit diagram (B)
5. Now connect the source and read the current value.

RESULT



i) Construction of a Transformer



ii) Equivalent Circuit of a Transformer

EX.NO:
DATE:

ASSEMBLING A TRANSFORMER

AIM

The learning objectives of Assembling of Transformer are

- Effects of electromagnetism.
- Effects of electromagnetic induction.
- Effects of magnetic coupling on voltage regulation.
- Effects of winding turns on "step" ratio.

APPARATUS REQUIRED

- Power transformer, 120VAC step-down to 12VAC
- Terminal strip with at least three terminals.
- Household wall-socket power plug and cord.
- Line cord switch.
- Fuse and fuse holder

THEORY

A transformer is a four-terminal device in which AC complex power is applied at one pair of terminals (the primary) and a load is driven at the other pair of terminals (the secondary). The transformer is a magnetically coupled device with no direct electrical connection between the primary and the secondary windings, so no DC power can pass through the device. The behavior of an actual transformer is rather complicated, but several simplified models are available for analyzing basic transformer circuits.

An ideal transformer is lossless, meaning that the complex output power at the load is equal to the complex input power. The ideal transformer can either *step up* or *step down* the AC output voltage (**V2**) with respect to the input voltage (**V1**) in order to obtain the desired voltage level at the load. Since no power is lost in the ideal transformer, stepping up the output voltage by a factor *n* results in **V2** = *n* **V1**, and **I2** = **I1**/*n*, where *n* is the *turns ratio* of the transformer, i.e., [# of turns in secondary winding]/[# of turns in primary winding]. The dots (.) at the top of the diagram in Figure 11.1 are used to indicate the polarity of the windings: a positive AC voltage **V1** results in a positive AC voltage **V2**.

If we assume that the transformer is ideal we can identify the complex (phasor) expressions which relate the terminal voltages and currents.

$$nV_1 = V_2 \quad I_1/n = I_2 \quad V_2/I_2 = Z_L$$

Using these expressions we can also write

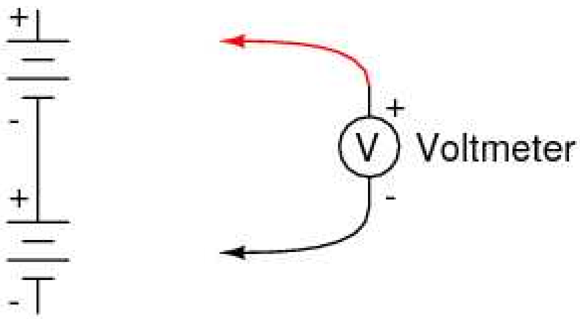
$$Z_1 = V_1/I_1 = (V_2/n)/nI_2 = (1/n^2)\cdot Z_L$$

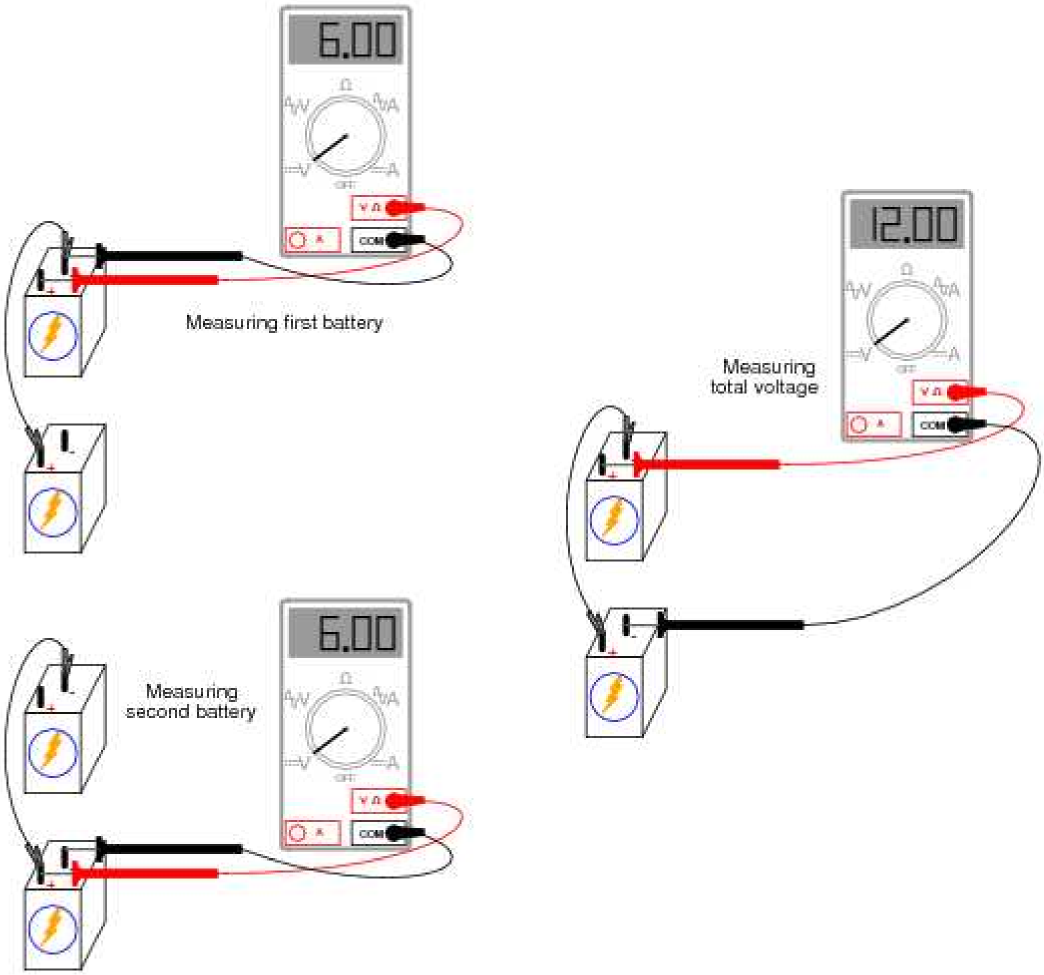
This result indicates that for an ideal transformer the input impedance seen at the primary is equal to the impedance attached to the secondary divided by the square of the turns ratio.

Wrap two, equal-length bars of steel with a thin layer of electrically-insulating tape. Wrap several hundred turns of magnet wire around these two bars. You may make these windings with an equal or unequal number of turns, depending on whether or not you want the transformer to be able to "step" voltage up or down. I recommend equal turns to begin with, then experiment later with coils of unequal turn count. Join those bars together in a rectangle with two other, shorter, bars of steel. Use bolts to secure the bars together (it is recommended that you drill bolt holes through the bars *before* you wrap wire around them).

Check for shorted windings (ohmmeter reading between wire ends and steel bar) after you're finished wrapping the windings. There should be no continuity (infinite resistance) between the winding and the steel bar. Check for continuity between winding ends to ensure that the wire isn't broken open somewhere within the coil. If either resistance measurements indicate a problem, the winding must be re-made. Measure the output voltage (secondary winding) of your transformer with an AC voltmeter. Connect a load of some kind (light bulbs are good!) to the secondary winding and re-measure voltage. Note the degree of voltage "sag" at the secondary winding as load current is increased. Loosen or remove the connecting bolts from one of the short bar pieces, thus increasing the *reluctance* (analogous to *resistance*) of the magnetic "circuit" coupling the two windings together. Note the effect on output voltage and voltage "sag" under load.

RESULT:





i) **Series Connection**

EX.NO:
DATE:

BRIGHT AND DIM LAMP METHOD

AIM

To connect batteries in Series and Parallel to perform Bright and Dim Lamp method at different voltage levels

APPARATUS REQUIRED

- One 9-volt battery
- Four 6-volt batteries
- 12-volt light bulb, 25 or 50 watt
- Lamp socket

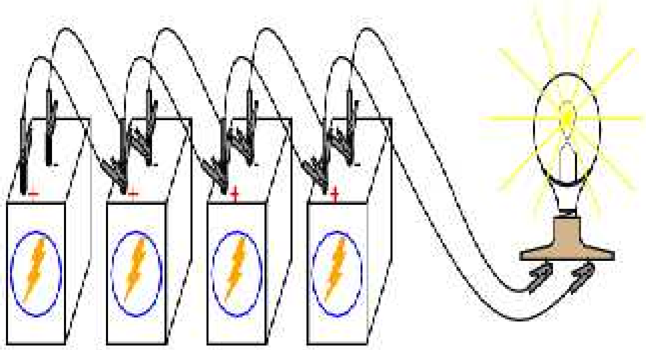
SERIES CONNECTION

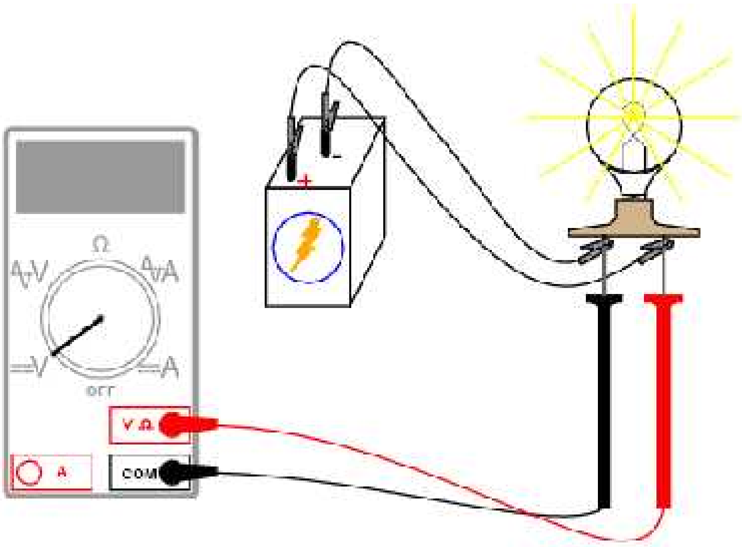
Connecting components in *series* means to connect them in-line with each other, so that there is but a single path for electrons to flow through them all. If you connect batteries so that the positive of one connects to the negative of the other, you will find that their respective voltages add. Measure the voltage across each battery individually as they are connected, then measure the total voltage across them.

PARALLEL CONNECTION

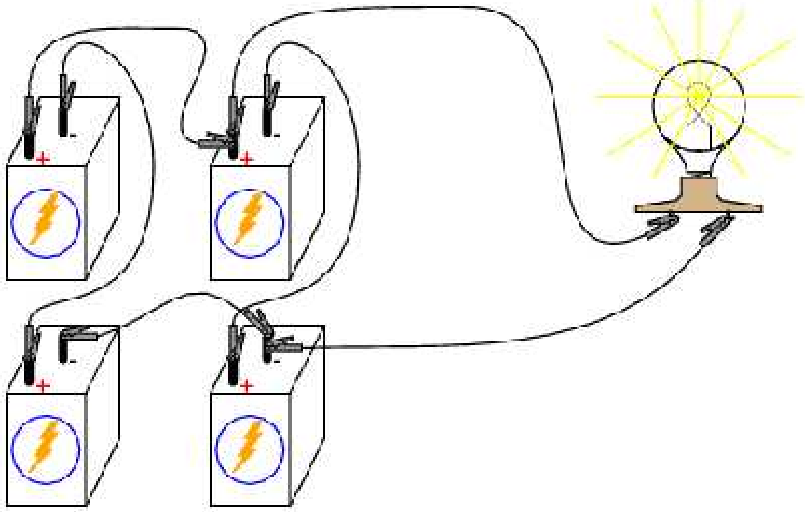
By connecting one 6-volt battery to the lamp. The lamp, designed to operate on 12 volts, should glow dimly when powered by the 6-volt battery. Use your voltmeter to read voltage across the lamp.

The voltmeter should register a voltage lower than the usual voltage of the battery. If you use your voltmeter to read the voltage directly at the battery terminals, you will measure a low voltage there as well. Why is this? The large current drawn by the high-power lamp causes the voltage at the battery terminals to "sag" or "droop," due to voltage dropped across resistance internal to the battery. We may overcome this problem by connecting batteries in *parallel* with each other, so that each battery only has to supply a fraction of the total current demanded by the lamp.





ii) Parallel Connection



iii) Series-Parallel Connection

Parallel connections involve making all the positive (+) battery terminals electrically common to each other by connection through jumper wires, and all negative (-) terminals common to each other as well. Add one battery at a time in parallel, noting the lamp voltage with the addition of each new, parallel-connected battery.By breaking the circuit for just one battery, and inserting our ammeter within that break, we intercept the current of that one battery and are therefore able to measure it. Measuring total current involves a similar procedure: make a break somewhere in the path that total current must take, then insert the ammeter within than break. To obtain maximum brightness from the light bulb, a *series-parallel* connection is required. Two 6-volt batteries connected series-aiding will provide 12 volts.

RESULT

VALLIAMMAI ENGINEERING COLLEGE

(AFFILIATED TO ANNA UNIVERSITY)

S.R.M. NAGAR, KATTANKULATHUR-603203

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

GE 6162 - ENGINEERING PRACTICES LABORATORY

PART - B ELECTRONICS LAB

LAB MANUAL

FIRST YEAR – I SEMESTER

(2015 -2016)

PREPARED BY

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ASSISTANT PROFESSOR – Selection Grade
DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

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NAME OF THE FACULTY:

DESIGINATION:

Signature of the faculty

ENGINEERING PRACTICE

PART B - ELECTRONICS LAB

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2. Study of logic gates AND, OR, NOR,Ex-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR

EX. NO.1

STUDY OF ELECTRONIC COMPONENTS AND EQUIPMENTS

AIM:

To study about the following electronic components and equipment.

(i). Resistor color coding

(ii). Usage of CRO (Cathode Ray Oscilloscope) and Multimeter

THEORY:

ELECTRONICS:

It is the branch of science, which relates to the conduction of electricity through a) vacuum, b) gases and c) semiconductors. The electronic devices are fairly complex, they are made of simple components such as: Resistors, Capacitors, inductors, tube devices and semi-conductor devices. Resistors, capacitors and inductors come under passive components and tube devices and semi-conductor devices fall under active components.

PASSIVE COMPONENTS

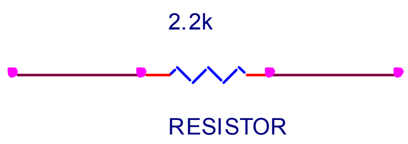
RESISTORS:

It is a passive electronic component, which exhibits the property of the 'resistance'. Resistance is a physical property of the material, which opposes the flow of current. Resistors are used in circuits to limit the flow of current or to provide a voltage drop.

UNIT:

Ohms (Ω)

SYMBOL:



TYPES

Resistors are broadly classified in to two categories as

1) Fixed Resistors
2) Variable Resistors

Fixed Resistors:

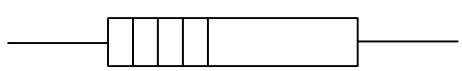
Fixed resistors are those whose values cannot be changed after manufacturing.

Variable Resistors:

Variable resistors are those whose values can be changed after manufacturing.

(i) RESISTOR COLOUR CODING

Resistance is coded to indicate the value and the Tolerance. For axial type resistors, four color bands are used as shown in figure.



The first three color bands indicate the resistance value and the fourth one indicates the tolerance. The first colour band gives the first significant digit and second colour band gives the second significant digit. Third colour band is the multiplier and gives the number of zeros that is to be added to the numerical value obtained from the first two bands. The following table gives the colour and its numerical value.

COLOUR	NUMBER	MULTIPLIER
BLACK	0	10^0
BROWN	1	10^1
RED	2	10^2
ORANGE	3	10^3
YELLOW	4	10^4
GREEN	5	10^5
BLUE	6	10^6
VIOLET	7	10^7
GREY	8	10^8
WHITE	9	10^9

TOLERANCE CODE:

BROWN COLOUR	$\pm$ 1 %
RED COLOUR	$\pm$ 2%
GOLD COLOUR	$\pm$ 5 %
SILVER COLOUR	$\pm$ 10 %
NO COLOUR	$\pm$ 20 %

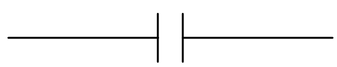
CAPACITORS:

A capacitor is a component that stores electric energy. It consists of two conducting plates, separated by an insulator. The conducting surfaces are called electrodes and the insulating medium is called dielectric.

UNIT:

Farads

SYMBOL:



TYPES:

In general capacitors are classified as

- Fixed Capacitors
- Variable Capacitors

Fixed Capacitors:

Fixed Capacitors are classified into several types depending upon the dielectric material used. Some of them are

- Paper Capacitors
- Film Capacitors
- Mica Capacitors
- Glass Capacitors
- Ceramic Capacitors
- Tantalum Capacitors

Variable Capacitors:

Variable capacitors consist of a set of fixed plates and a set of movable plates with air as dielectric. The change of capacitance is obtained by changing the position of the moving plates with respect to fixed plates.

- Trimmer Capacitors
- Ceramic trimmer Capacitors
- Mica trimming Capacitors

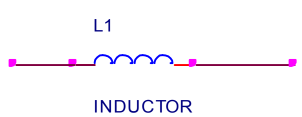
INDUCTORS:

Inductor is a component whose construction is simply a coil of wire. The property of a coil by which it opposes change in the value of current or flux through it due to the production of self-induced E.M.F. is called inductance. An inductor consists of a number of turns of wire used to introduce inductance into an electric circuit and produces magnetic flux.

UNIT:

Henrys

SYMBOL:



TYPES:

1. Fixed Inductors

a) Air-core inductor
b) Iron-core inductor
c) Ferrite core inductor

2. Variable Inductors

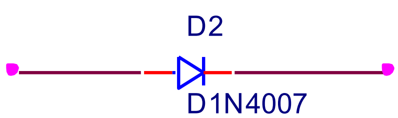
ACTIVE COMPONENTS

PN JUNCTION DIODE:

A single piece of semiconductor, one half of which is P-type and the other half is N-type is known as PN junction diode. The plane dividing the two halves is known as PN junction diode. Diode is an electronic component, which allows current to flow through it in one direction but not in opposite direction. The current is flowing through a diode, when the voltage on the positive is higher than the negative.

The main function of a diode is rectification.

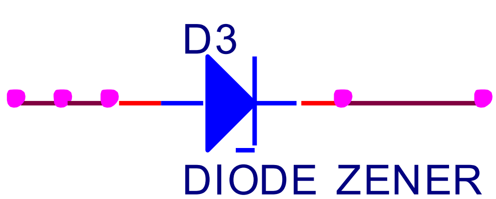
SYMBOL:



ZENER DIODE:

It is reversed biased PN junction diode, which is operated in break down region. It is used for meter protection and as voltage regulators.

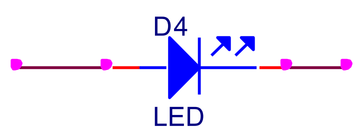
SYMBOL:



LED (LIGHT EMITTING DIODE):

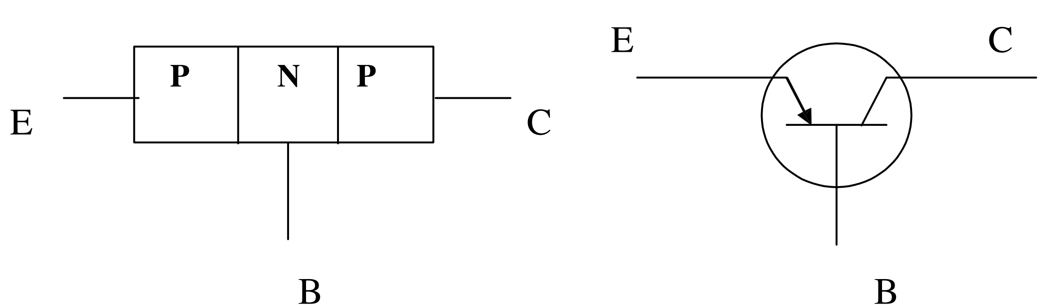
Light Emitting diodes have same properties as diode when forward biased. Their threshold voltage is 1.6V to 2.4V.LED's use a special material, which emits light when current flows through it. LED has a positive terminal (anode) and a negative terminal (cathode) just like regular diodes. Often, positive terminal is longer than negative terminal.

SYMBOL:

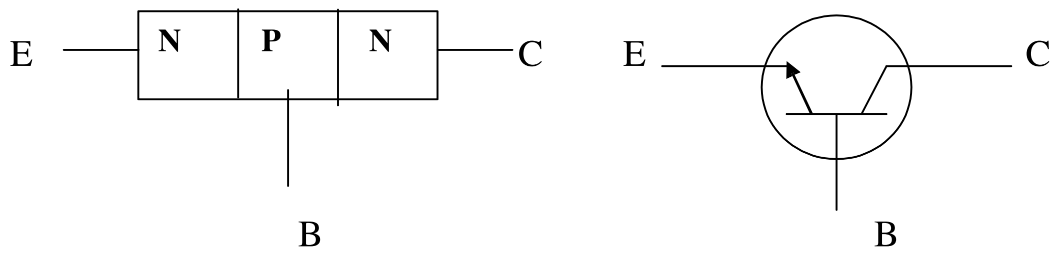


TRANSISTORS:

It is a three terminal semiconductor device, consisting of two p-n junctions, formed by sand witching a thin layer of n-type semi-conductors between two layers of p-type semi-conductors. This type of transistor is known as p-n-p transistor. On the other hand, when a layer of p-type semi-conductor is sand witched between two layers of n-type semi-conductor material, it is known as n-p-n transistor.



SYMBOL P-N-P



SYMBOL N-P-N

(ii) USAGE OF CATHODE RAY OSCILLOSCOPE AND MULTIMETER

CATHODE RAY OSCILLOSCOPE

The CRO is a versatile electronic testing and measuring instrument that allows the amplitude of the signal which may be voltage, current, power etc., to be displayed primarily as a function of time. It is used for voltage, frequency and phase angle measurement and also for examining the waveforms, from d.c or very low frequency to very high frequencies.

CRO comprises the main sections of (i) Horizontal and vertical voltage amplifiers, (ii) Power supply circuits and (iii) Cathode Ray Tube (CRT).

APPLICATIONS:

- Measurement of voltage
- Measurement of current
- Measurement of frequency
- Measurement of phase difference

MULTIMETER

An instrument used to measure voltages, currents and resistances known as MULTIMETER. It is an indispensable instrument and can be used for measuring D.C. as well as A.C. Voltages and Currents. Multimeter is the most inexpensive equipment and can make various electrical measurements with reasonable accuracy. There are two types of multimeters - analog and digital. The digital multimeter is commonly used in laboratory and workshop because of its high input resistance.

APPLICATIONS:

- For checking the circuit continuity.
- For measuring D.C. Current flowing through the circuits.
- For measuring D.C. Voltages across various resistors in electronic circuits.
- For measuring A.C. Voltage across power supply transformers.
- For ascertaining whether or not open or short circuit exists in the circuits.

RESULT:

Thus the study of basic electronic components have been studied.

EX.NO: 1(a)

MEASUREMENT OF AC SIGNAL PARAMETER

AIM:

To measure peak, RMS, peak to peak, period and frequency of an alternating quantity (sinusoidal voltage) by using CRO

APPARATUS REQUIRED

S.NO	APPARATUS	TYPE	RANGE	QUANTITY
1	CRO	Dual	30MHz	1
2	Function Generator	-	30MHZ	1
3	connecting wires	-	-	Few

THEORY

AC FUNDAMENTALS

Alternating quantity:

A quantity in which the magnitude and direction change with respect to time is called an alternating quantity.

Example: sinusoidal quantity

Cycle

One complete set of changes in magnitude and direction of any alternating quantity is called a cycle

Period

Time taken by an alternating quantity to complete one cycle is called period. Its unit is seconds.

AC WAVEFORM:

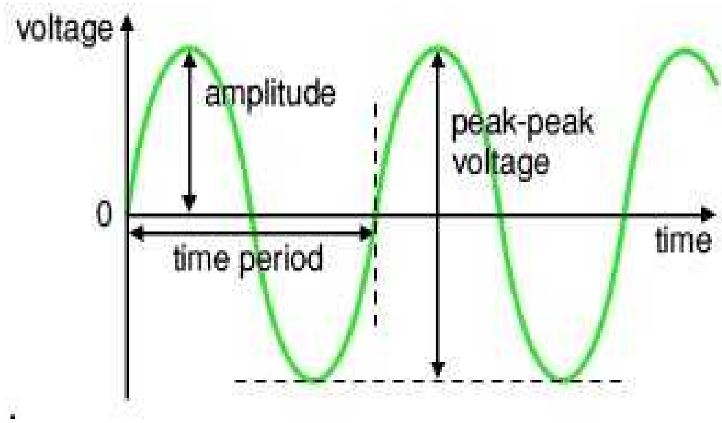


Fig.1.Wave form with amplitude and peak-peak voltage & time period.

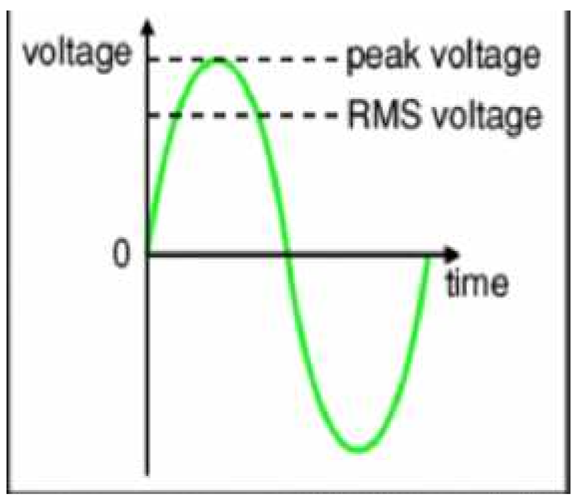


Fig.2.Wave form with peak voltage & RMS voltage.

FREQUENCY:

The number of cycles completed by an alternating quantity per second is called frequency. Its unit is Hertz.

PEAK VALUE OR AMPLITUDE:

The maximum value that an alternating quantity attains during a cycle is called peak value or Amplitude. There are positive and negative peak values. The magnitude between these two peaks is called peak-peak value.

ROOT MEAN SQUARE VALUE (RMS):

It is that value of direct current which when flows through the given circuit for a given amount of time produces same heat as that of an alternating current flowing through the same circuit for the same amount of time .It is also called as effective or virtual value .

TABULATION:

S.No.	No. of divisions in X-axis of CRO monitor	No. of divisions in Y-axis of CRO monitor	Voltage base reading (Volt)	Time base reading (m Sec)	Peak value (Volt)	Peak to Peak Value (Volt)	RMS value (Volt)	Time Period (m Sec)	Frequency (Hertz)

CALCULATION:

Frequency =1/ time period

Vrms = 0.7 × Vpeak

$I_{rms} = I_{max} \times 0.707$

Where $I_1, I_2, I_3 \ldots\ldots I_n$ are the instantaneous value of an alternating current and I_{max} is the peak value of the alternating current.

PROCEDURE:

1. Output of the function generator is connected to one of the channels of CRO through a probe.

2. AC supply to CRO is switched on and the switch in CRO is closed.

3. CRO is kept in dual mode and ground knobs in the two channels are enabled.

4. Focus and intensity knobs in CRO are suitably adjusted to observe both the ground signals. If there is any problem in tracing the signal position X and Y position knobs are suitably adjusted.

5. Function generator is switched on. Sinusoidal quantity is chosen as the output signal.

6. Amplitude of the sinusoidal quantity is varied and maintained at a particular value

7. Frequency of the sinusoidal quantity is varied and maintained at a particular value.

8. The sinusoidal output of function generator is observed using CRO by enabling AC knob and disabling ground knob in the channel to which function generator is connected.

9.peak value ,peak-peak value of the sinusoidal waveform are observed by noting the number of divisions in Y axis CRO monitor and the value of the voltage in the voltage base knob.

10. Peak value and peak-peak values of the sinusoidal wave can be calculated as the product of number of divisions in Y-axis of CRO monitor and value of the voltage in the voltage base knob.

11. CAL knob in the most anti-clockwise position. Number of divisions in X axis of CRO monitor and value of the time in the time base knob are noted.

12. Time period of the sinusoidal wave is obtained by multiplying the number of divisions in X axis of CRO monitor and value of the time in the time base knob.

13. Reciprocal of the time period is the frequency of the sinusoidal waveform. Frequency can also be checked by noting the digital value in the function generator.

14. RMS voltage of the sinusoidal wave is obtained by multiplying the peak voltage with 0.707.

RESULT:

Thus, Peak, RMS, peak to peak values, period and frequency of a sinusoidal voltage waveform are observed and measured by using CRO.

EX.NO.2

STUDY OF LOGIC GATES

AIM:

To study the operation of logic gates and verify their truth table.

APPARATUS REQUIRED:

S.NO	COMPONENTS	QUANTITY
1	Digital trainer	1
2	IC 7404(NOT gate)	1
3	IC7408(AND gate)	1
4	IC7432(OR gate)	1
5	IC7486(Ex-OR gate)	1
6	IC 7402(NOR gate)	1
7	IC 7400(NAND gate)	1

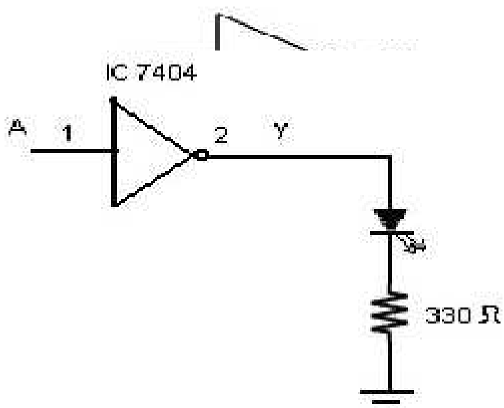
THEORY:

Logic gates are digital circuits with one or more input signals and only one output Signal. Gates are digital circuits because the input and output signals are either low or High voltages. Gates are often called logic circuits because they can be analyzed using Boolean algebra.

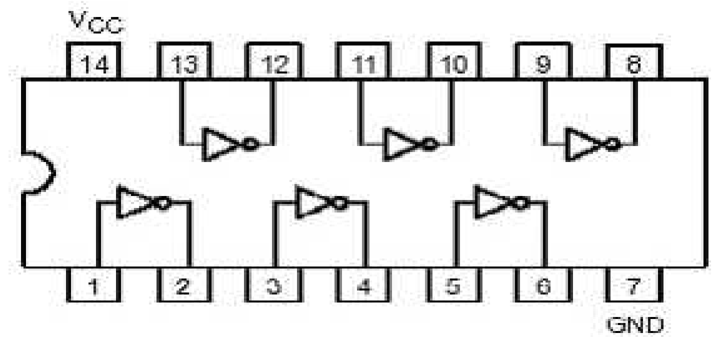
NOT GATE: IC7404

A NOT gate has a single input and a single output. It is also called as an inverter. The output will be at logic 1 if its input is at low state, otherwise its output will be at Logic 0. Thus its output is the complement of its input. The Boolean expression for NOT GATE **Y = Ā**

SYMBOL



PIN CONFIGURATION



TRUTH TABLE

INPUT	OUTPUT
A	**Y**
0	1
1	0

AND GATE: IC7408

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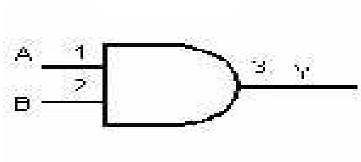
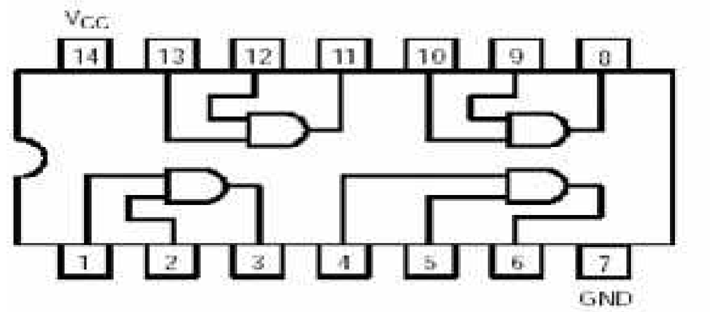
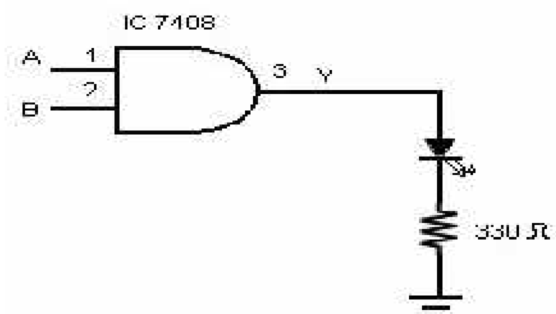
a two





TRUTH TABLE

Boolean expression for AND GATE **Y = A.B**

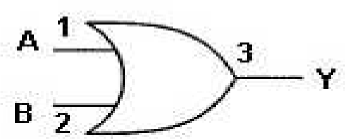


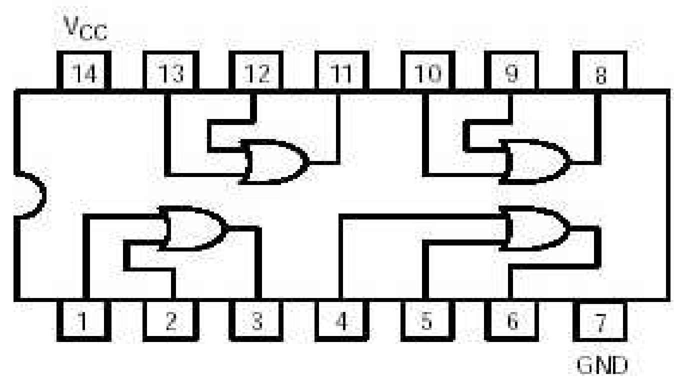
INPUT		OUTPUT
A	**B**	**Y**
0	0	0
0	1	0
1	0	0
1	1	1

OR GATE: IC7432

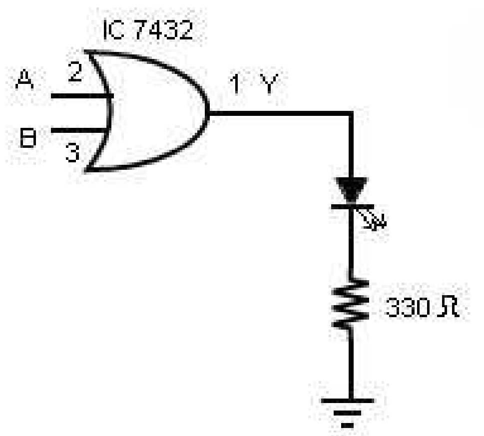
An OR gate can have two or more inputs but only one output. Its output will be at Logic 1 if any or both of its inputs are at the high state. The Boolean expression for a two input OR gate is: **Y= A+B**

SYMBOL **PIN CONFIGURATION**





Boolean expression for OR GATE Y **= A+B**



TRUTH TABLE

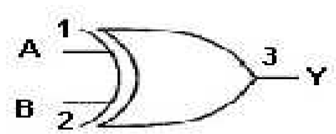
INPUT		**OUTPUT**
A	**B**	**Y**
0	0	0
0	1	1
1	0	1
1	1	1

EX-OR GATE: IC7486

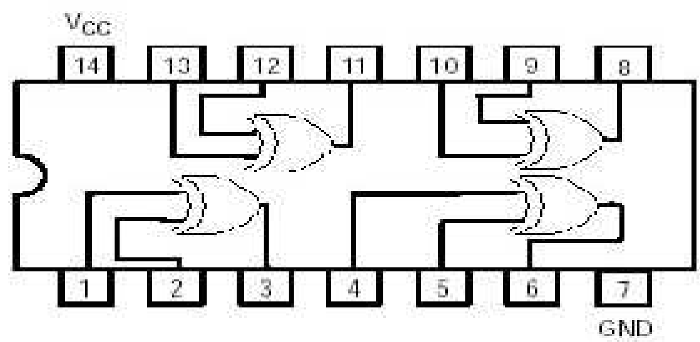
It has two or more inputs and a single output. The output of the EX-OR gate is high if the inputs are different and low if the inputs are same.

The Boolean expression for a two input EX-OR gate is: Y = A+ B

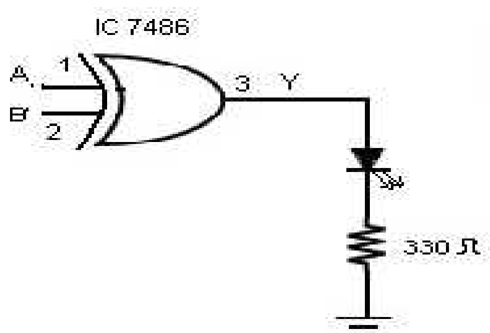
SYMBOL



PIN CONFIGURATION



BOOLEAN EXPRESSION $Y = A \oplus B$



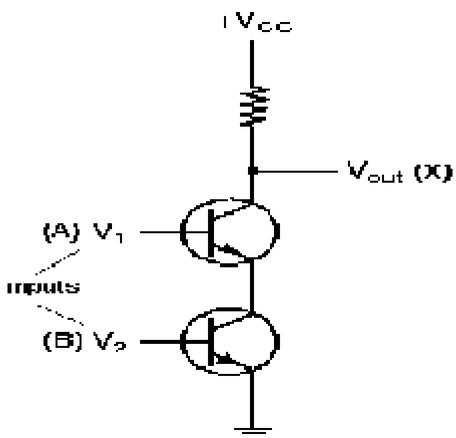
TRUTH TABLE

INPUT		**OUTPUT**
A	**B**	**Y**
0	0	0
0	1	1
1	0	1
1	1	0

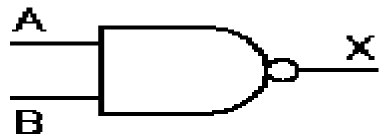
NAND GATE: IC7400

It is the combination of AND gate and NOT gate. It is also called as an universal gate. The output of this gate will go to logic 0 if all its inputs are at the high state.

The Boolean expression for a two input NAND gate is: **Y=⍰**

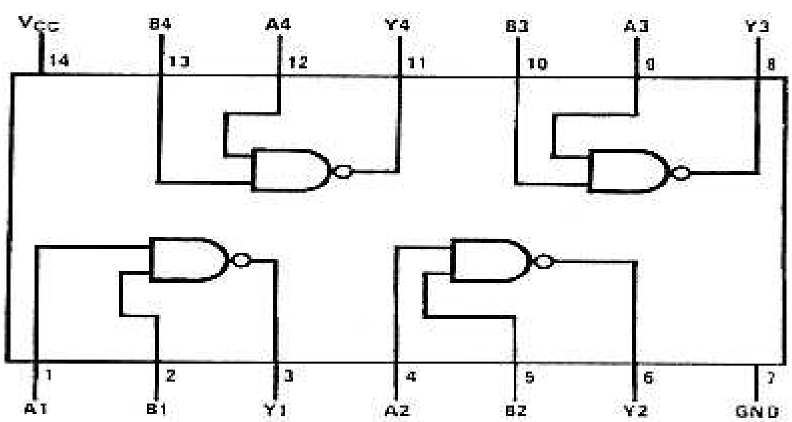


SYMBOL



A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

PIN CONFIGURATION

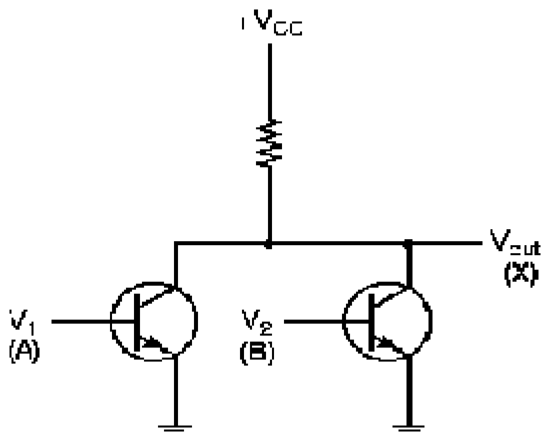


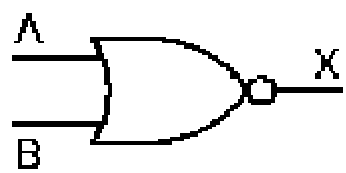
NOR GATE: IC 7402

It is the combination of an OR gate and a NOT gate. It is also called as an universal gate. The output of this gate will go to logic 1 if all its inputs are at the low state.

The Boolean expression for a two input NOR gate is: **Y=**□

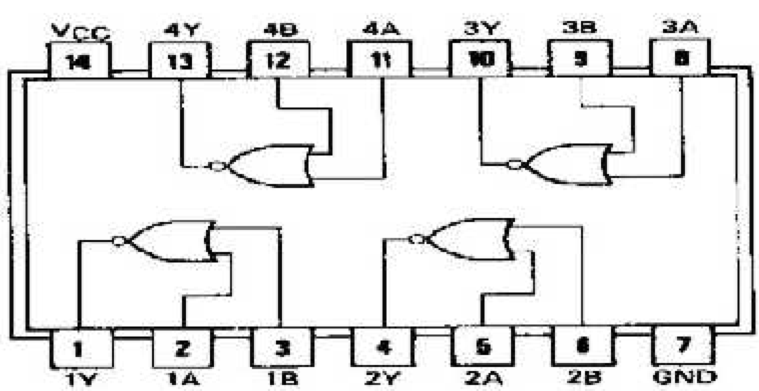
SYMBOL





A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

PIN CONFIGURATION



PROCEDURE:

1) Connections for all the gates namely NOT, AND, OR and EX-OR are given as per the circuit diagram.
2) Pin No.7 is connected to ground and pin No.14 is connected to +Vcc of +5V.
3) Outputs are noted for various combinations of inputs and the truth table is verified.

RESULT:

Thus the logic gates are studied and their truth tables are verified.

Ex.NO:3 GENERATION OF CLOCK SIGNAL

AIM:

To generate a clock signal using the IC 555 timer in Astable mode.

COMPONENTS REQUIRED:

S.NO	NAME OF THE COMPONENT	SPECIFICATION	QUANTITY
1.	IC	555 Timer	1
2.	Resistors	2.2 kΩ 3.3 kΩ	1 1
3.	Capacitors	0.1µF 0.01 µF	1 1
4.	Power supply	30 V	1
5.	Bread board & connecting wires	_	_

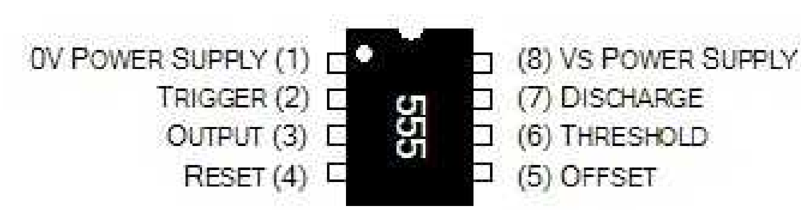
THEORY:

Multivibrator is basically a two stage amplifier with output of one feedback to the input of the other. This integrated chip generates the clock signal of its own. It does not require external pulse for its operation but a source of DC power. The width of the square wave and its frequency depend upon the circuit constants.

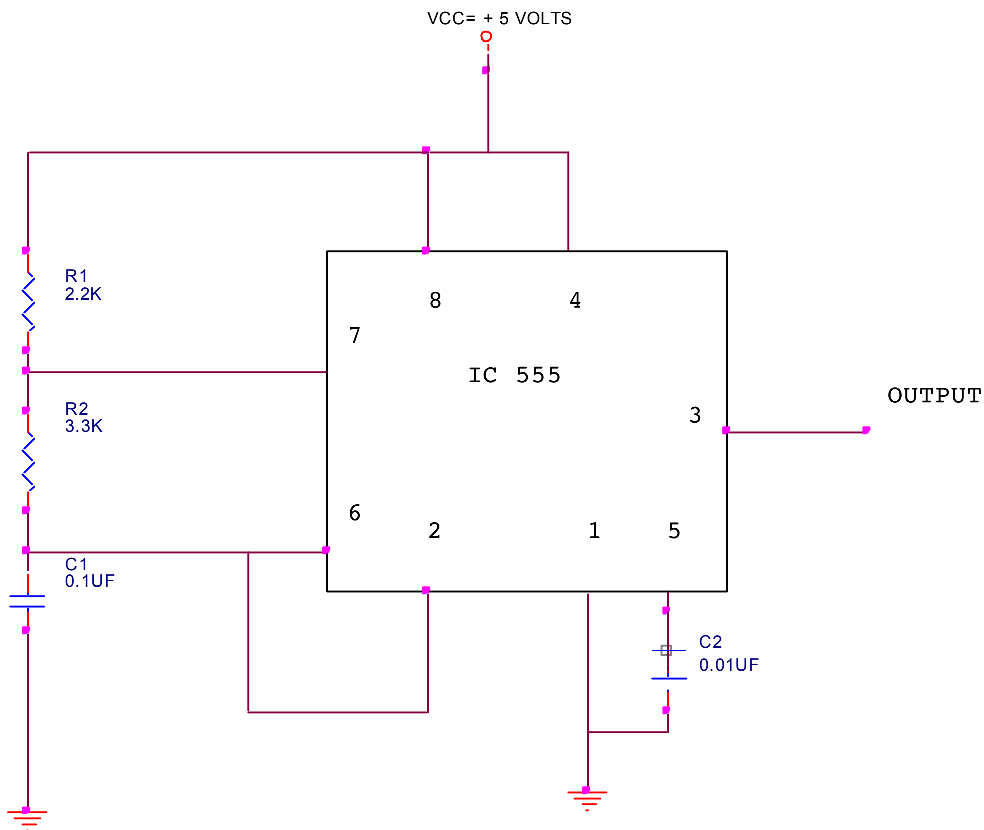
The 555 timer has three operating modes:

- **Monostable mode**: In this mode, the 555 functions as a "one-shot". Applications include timers, missing pulse detection, bounce free switches, touch switches, frequency divider, capacitance measurement, pulse-width modulation (PWM) etc.
- **Astable - free running mode**: The 555 can operate as an oscillator. Uses include LED and lamp flashers, pulse generation, logic clocks, tone generation, security alarms, pulse position modulation, etc.
- **Bistable mode or Schmitt trigger**: The 555 can operate as a flip-flop, if the DIS pin is not connected and no capacitor is used. Uses include bounce free latched switches, etc.

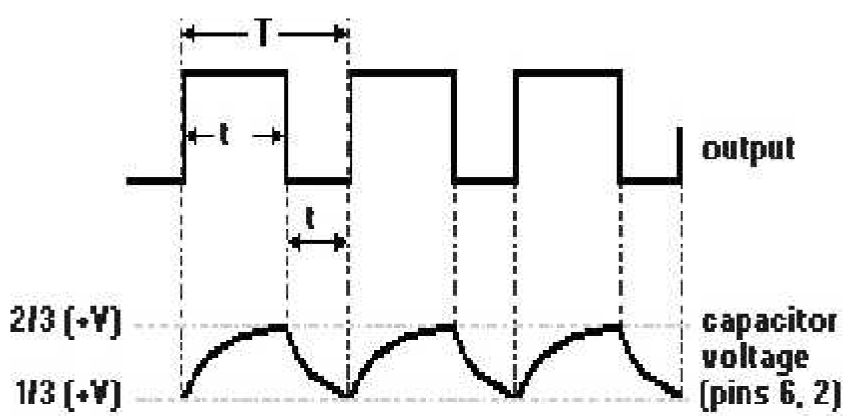
PIN DIAGRAM:



CIRCUIT DIAGRM:



MODEL GRAPH:



TABULATION:

	X-AXIS	Y-AXIS	TIME(DIV)	VOLT(DIV)	AMPLITUDE IN VOLTS	TIME IN ms
OUTPUT						

PROCEDURE:

1. Connections are made as per the circuit diagram after designing suitable values of R1, R2 and C for the desired clock frequency, ON and OFF times.
2. Pin.8 is connected to the supply.
3. Pin.3 is connected to the CRO for observing the output clock signal.
4. ON and OFF times are measured from CRO. Time period and frequency are then calculated.

RESULT:

Thus a clock signal using the IC 555 timer is generated in Astable mode.

EX.NO:4

SOLDERING PRACTICE – COMPONENTS DEVICE AND CIRCUITS

AIM:

- To assemble and solder the electronic components on a printed circuit board for the given circuit.

APPARATUS REQUIRED:

S.No.	Components	Quantity
1.	Soldering rod, Soldering lead,	1
2.	Flux.	1
3.	Resistor.	As per Circuit.
4.	Capacitor.	As per Circuit.
5.	Signal generator	1

THEORY:

Printed circuit board is the base plate over which all components are mounted and soldered. The inter connection between the components made by in metallic tracks. Etching process in PCB removes all the excess copper from the base lamination. After this only the printed pattern is left behind. A solution of 75 degree Celsius heated tap water and ferric chloride is used to remove the excess copper. The above said solution thoroughly surrounded and speeded up the process few drops of HCL be added.

COMPONENT PLACEMENT:

- The placement of components affects circuit operation manufacturing case and the probability of design errors. Improper layout can be grade operation or even prevent a circuit from working. Future more, poor layout can make manufacture of the circuit boards costly and difficult. Thoughtless placement of components and complicates the design of the PCB and will increase the chance of wrong connections.
- You should group circuits according to their characteristics to maintain the correct operation of each circuit. In general follow these rules.
- Group high- current circuits near the connector to isolate stray currents and near the edge of the PCB to remove heat.
- Group low power and low frequency circuits away from high current and high frequency circuits.
- Group of high frequency circuits near the connector to reduce path length cross talk and noise.
- Group analog circuit separately from digital logic.
- Grouping components & circuits appropriately will reduce cross talk efficiently.
- Careful placement of the board will make production of circuit easier and less error prone. Determine the location and direction of the components so that a pick & place machine can easily assemble a circuit board without manual intervention.
- Allow plenty of clearance around mechanical supports. It is embarrassing and costly to find a trace shorted to an enclose post or a component jammed against the card cage. If possible leave room around large and complex components for sockets on the prototype boards to speed testing and development.

PROCEDURE:

(i) For assembling electronic components in PCB board

- Study the given electronic circuit.
- The master pattern of PCB is made on a thick sheet with a reverse carbon placed under to take the mirror image on reverse side of the sheet.
- Clean the copper side of the PCB with alcoholic spirit or petrol in order to make it free from dust and contaminations.
- The mirrors image of pattern is copied to the base laminate on the board with the help of ball point pen. Holes position should be marked carefully.
- The copied track is marked with the help of enamel point or use silver pen.
- The board is dipped in a solution of $FeCl_3$ for some time to remove the excess copper then it should be cleaned under running water and it should be dried.
- The marker ink/Point is removed with the help of alcohol or petrol.
- Using a driller, holes of suitable diameter are drilled on the board and then clean the hole.
- Varnish coating is given on the PCB in order to prevent the oxidation.
- Using Continuity tester, the board is tested for continuity.

ii) For soldering a low pass filter circuit consisting of a resistor and capacitor and checking the continuity.

- The terminal of the resistor and capacitor are thoroughly cleaned.
- The joint to be made is tinned says the joint.
- A soldering gun is heated using powder supply till it attains the required temperature.

- Using the heated soldering gun, the tinned joint is soldered.
- A small AC signal nearby or equal to 5V is applied between the terminals B & C.
- Using the multimeter the continuity of the circuit is checking.

Note:

If the circuit is continuous while checking beep sound will come when the multimeter is put in beep node. If the circuit is not continuous no beep sound will come.

Precaution:

The terminal of the components should be thoroughly cleaned also soldering care should be taken while selecting the proper size of soldering HD.

SOLDERING SIMPLE ELECTRONIC COMPONENTS:

A printed circuit board (PCB) consists of copper strips and pads bonded to a plastic board. The copper strip is the network of interconnecting conductive path. Leads of components mounted on the board are inserted through holes on the board and the conductive copper. These leads are soldered to the copper at the end of the hole. If excessive heat is applied to copper, it may get lifted from the board or the components on the board get damaged. Soldering pencil gun of about 30 Watts is used to heat the junction. The surface of copper bonded to the board should be properly prepared and cleaned before soldering. Flux is applied on circuits and component leads.

Check the conductive strips and pads on the board before soldering. Avoid excess solder to prevent two copper paths from bridging. When solder globules form on the junction area, remove them by cleaning the soldering tip using a cloth.

CHECKING CONTINUITY:

The continuity of a wire conductor without a break has practically zero ohms of resistance. Therefore, an ohmmeter may be used to test continuity. To test continuity, select the lowest ohm range. A wire may have an internal break, which is not visible due to insulation, or the wire may have a bad connection at the terminals. Checking for zero ohms between any two points tests the continuity. A break in the conducting path is evident from the reading of infinite resistance. In a cable of wires, individual wires are identified with colors. Consider the figure, where the individual wires are not seen, but you wish to find the wire that connects to terminal A. This is done by, checking continuity of each wire to terminal A. The wire that has zero ohms is the one connected to this terminal. Continuity of a long cable may be tested by temporarily short-circuiting the other ends of the wires. The continuity of both wires may be checked for zero ohms. In a digital multimeter, a beep mode is available to check continuity. The connectivity between the terminals is identified by the beep sound.

RESULT:

Thus, the electronic components via resistor and capacitor were joined through soldering and continuity of a circuit is checked successfully.

EX.NO:5

MEASUREMENT OF RIPPLE FACTOR OF HALF WAVE & FULL WAVE RECTIFIER

AIM:

To design half wave and full wave rectifiers filter and to measure the ripple factor.

APPARATUS REQUIRED:

SL.No	Instruments/Components Required	Type/range	Quantity
1.	Transformer	(9-0-9)v	1
2.	Resistor	1KΩ	1
3.	CRO	30 MHz	1
4.	Bread board	-	1
5.	Connecting Wires	Single Strand	few

THEORY:

Half Wave Rectifier

In a half wave rectifier only one diode is used in the secondary of the transformer, during the positive half cycle the diode conducts and only the positive portion of the input signal is delivered to the load. During the negative half cycle the diode will not conduct, since it is reverse biased and there is no output delivered to the load.

Full Wave Rectifier Using Centre Tapped Transformer

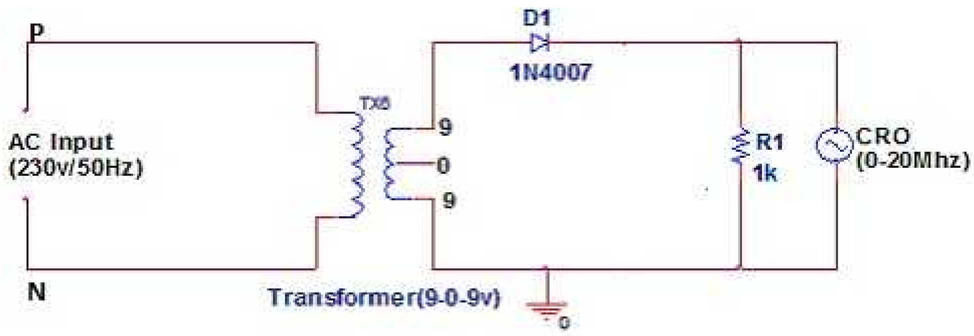
The full wave Centre tapped rectifier uses two diodes connected to the secondary of Centre tapped transformer. The input voltage is coupled through the transformer to the Centre tapped secondary, half of the total secondary voltage appears between the Centre tapped and each end of the secondary winding. For a positive half cycle of the input voltage, the upper diode $\mathbf{D_1}$ is forward biased and the lower diode $\mathbf{D_2}$ is reverse biased. The current path is through $\mathbf{D_1}$ and load ($\mathbf{R_L}$), for negative half cycle of the input voltage the diode $\mathbf{D_1}$ is reverse biased and diode $\mathbf{D_2}$ is forward biased. Now the current path is through diode ($\mathbf{D_2}$) and resistor ($\mathbf{R_L}$), because of output current during both cycle is in same direction, the output voltage developed across the load resistor is a full wave rectified voltage.

Full Wave Bridge Rectifier

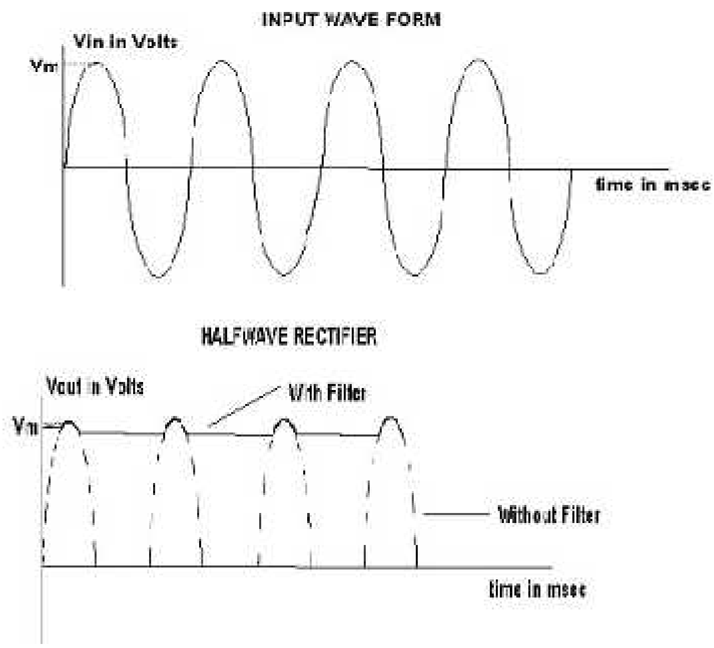
The full wave bridge rectifier uses four diodes, when the input cycle is $+^{ve}$, the diode $\mathbf{D_2}$ **&** $\mathbf{D_3}$ are forward biased and conducts current , the voltage is developed across $\mathbf{R_L}$ which is the $+^{ve}$ half of the input cycle during this time $\mathbf{D_1}$ **&** $\mathbf{D_4}$ are reverse biased. When input cycle is $-^{ve}$ the diodes $\mathbf{D_1}$ **&** $\mathbf{D_4}$ are forward biased and conducts current in same direction through $\mathbf{R_L}$ as during $+^{ve}$ cycle. During $-^{ve}$ half diode $\mathbf{D_2}$ **&** $\mathbf{D_3}$ are reverse biased, so a full wave rectifier output appears occurs the $\mathbf{R_L}$ as a result of this action.

CIRCUIT DIAGRAM

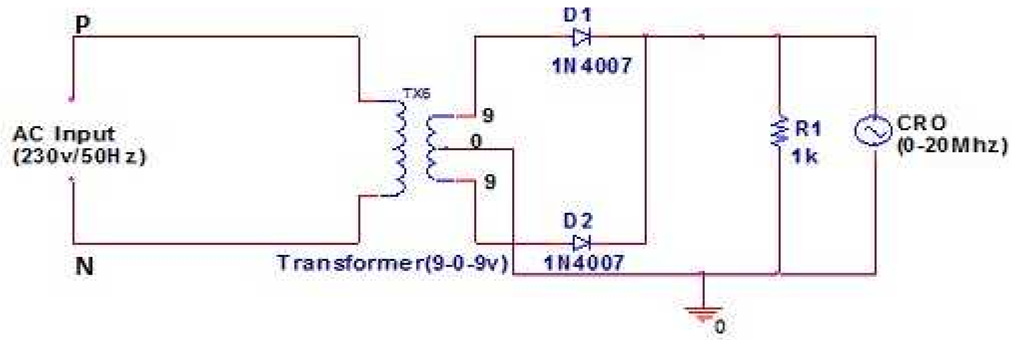
Half Wave Rectifier



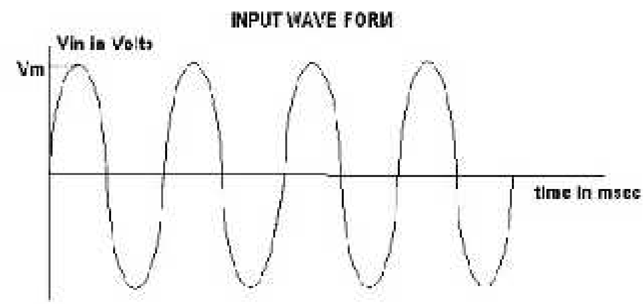
MODEL GRAPH:

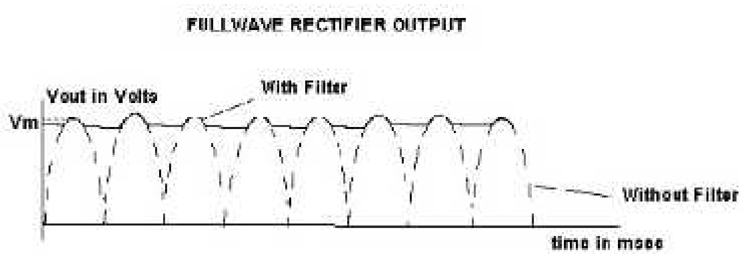


Full Wave Rectifier



MODEL GRAPH





TABULATION

INPUT:

RECTIFIER TYPE	AMPLITUDE	TIME PERIOD
HALFWAVE		
FULLWAVE		

HALFWAVE RECTIFIER:

S.NO	Vm(v)	Vac	Vdc	r = (Vac/Vdc)*100

FULLWAVE RECTIFIER:

S.NO	Vm(v)	Vac	Vdc	r = (Vac/Vdc)*100

Rectifier type	% of Ripple factor	
	Theoretical value	Practical value
Half wave	121	
Full wave	48	

CALCULATION

Half wave rectifier

The RMS voltage is given by $V_{rms} = \frac{V_m}{2}$

The average dc voltage for half wave rectified output is $\mathbf{V_{dc} = V_m / \pi}$
The ripple factor is calculated as $V_{ac}^2 = V_{rms}^2 - V_{dc}^2$

Therefore ripple factor(r) % = $\frac{V_{ac}}{V_{dc}} \times 100$

Full wave Rectifier

The RMS voltage is given by $V_{rms} = \frac{V_m}{\sqrt{2}}$

The average dc voltage for half wave rectified output is $\mathbf{V_{dc} = (2V_m) / \Pi}$
The ripple factor is calculated as $V_{ac}^2 = V_{rms}^2 - V_{dc}^2$

Therefore ripple factor(r) % $= \frac{V_{ac}}{V_{dc}} \times 100$

PROCEDURE:

1. Connections are made as per the circuit diagram, with correct polarity provision given to the circuit from the transformer.
2. The Peak voltage (**V_m**) is noted and the corresponding % of ripple factor(**r**) is calculated and compared with theoretical calculation.

RESULT:

Thus half wave and full wave rectifier is designed, ripple factor is measured and output is verified.

LABORATORY RULES AND REGULATION

GENERAL RULES

1. Students are expected to act responsibly in all laboratories at all times.
2. Students should avoid coming late to the lab. It is not appreciated
3. Students may not enter the laboratory until the Lab. Asst./ lab i/c are present.
4. Any person entering a laboratory is required to have appropriate clothing and footware. Footware must fully enclose the foot. Thongs and partial footware is not acceptable.
5. No food or beverages are permitted in any laboratory.
6. Students may not enter a laboratory if they are affected by alcohol.
7. Cases and bags are not to be brought in but to be placed outside.
8. Students are not permitted to stand or sit on benches, or employ them for any other purpose than conducting the appropriate test.
9. Students may not bring personal equipment to a laboratory outside of calculators and stationery without the permission of the Lab incharge.
10. Students may not use laboratory for any private purposes.
11. The Observation and Record note should be covered with brown paper
12. Before entering the lab, ensure that the observation for previous experiment was corrected and the same is written in the record note book

RULES FOR CONDUCTING AN EXPERIMENT IN THE LABORATORY

1. Prepare for the Viva Questions for the experiment that has to be done on a particular day. Without Answering Viva questions, you will not be permitted to do the experiment.
2. Do the Experiment without others help. For assistance please call the staff i/c. Do not consult your class mates or lab technician for any doubts. Clear your doubts with Staff. I/c
3. Do not leave the equipments on the table after the experiment . return it back to the lab asst. before leaving ensure that you have taken your personal belongings and placed back the chairs in their position
4. Students are not permitted to attempt repair, calibrate or modify any equipment in a laboratory at any time. They should either seek the assistance of the laboratory assistant, or fill in a laboratory fault report.
5. Students may not move equipment - including chairs - from one laboratory area to another without the permission of the staff.
6. All circuits must be checked by the laboratory supervisor before power is applied
7. No circuit is to be left unattended while powered. If it is necessary to absent a laboratory, then students should remove power
8. Instruments should be set to their highest range, then power applied and the instrument adjusted down as measurements are taken

ELECTRICAL SAFETY PROCEDURES

• Currents only slightly in excess of one’s let-go current (the current at which a person is frozen to the circuit and unable to let go) are said to “freeze” the victim to the circuit.

• Prolonged exposure to currents only slightly in excess of a person’s let - go limit may produce exhaustion, asphyxia, collapse, and unconsciousness followed by death.

1. Equipment producing a "tingle" should be reported promptly for repair.
2. “Shorts” (ground faults) are extremely hazardous especially where in contact with metal frame-work of an exhaust hood or damp floor.
3. Do not rely on grounding to mask a defective circuit nor attempt to correct a fault by insertion of another fuse, particularly one of larger capacity.
4. Keep use and length of extension cords to a minimum.
5. Work on electrical devices should be done after the power has been disconnected or shut off and suitable precautions taken to keep the power off during the work.
6. Never work on live equipment (over 25 volts) alone.
7. Use only tools and equipment with non-conducting handles when working on electrical devices.
8. Treat all electrical devices as if they are live.
9. Drain capacitors before working near them or removing the device from service, and keep the short on the terminals during the work since some of the charge may return due to a dielectric effect.
10. Never touch another person’s equipment or electrical control devices unless instructed to do so.
11. Enclose all electric contacts and conductors so that no one can accidentally come into contact with them.
12. Never use metallic pencils or rulers, or wear rings or metal watchbands when working with high voltage (>25V) electrical equipment.
13. Laboratory wiring should be done by electricians. Electronic equipment wiring should be done by trained technicians or electronic engineers, or by students under professional supervision.
14. Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor.
15. With high voltages regard all floors as conductive and grounded unless covered with well maintained and dry rubber matting of suitable type for electrical work.
16. Whenever possible, use only one hand when working on circuits or control devices.
17. When it is necessary to touch electrical equipment (for example, when checking for overheated motors), use the back of the hand. Thus, if accidental shock were to cause muscular contraction, you would not "freeze" to the conductor.
18. Avoid using or storing highly flammable liquids near electrical equipment.
19. Keep in mind that on some equipment the interlocks disconnect the high voltage source when a cabinet door is open but power for control circuits remains on.
20. De-energize open experimental circuits and equipment if left unattended.
21. Unplug cords by gripping the plug end, do not pull on the cord.
22. Do not wear loose clothing or ties near rotating equipment.