DESIGN AND MANUFACTURING LABORATORY

ID1000

Lab Manual

IIITD&M Kancheepuram

Academic Year-2023-2024

Safety Precautions:

- Wear khaki uniform –Pant & shirt (tuck-in) for boys; over-coat for girls
- Don’t wear loose fitting cloths & jewelry. Long-hair should be tied properly
- Wear leather shoe
- Wear safety glass, hand gloves, apron and dust mask (wherever required)
- Listen the instructions carefully before doing the experiment
- Use of mobile phones in workshop is strictly prohibited –keep your mobiles in switch- off mode
- To avoid accidents don’t rush in workshop
- Keep hands away from moving, rotating parts & hot surfaces
- Be aware of emergency stop buttons of machine
- Report immediately as soon as you identify any damage in machinery & equipment
- Don’t touch the live wire, electric bulb, hardware components of computer
- Don’t touch (with bare hands) the cutting tool edge, blade & drill bit

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Exp.No : 01 (A)	Fitting
Date :	

Fitting is a fundamental material cutting process, where the raw material is gradually removed by rubbing against a tool called file.

Objective

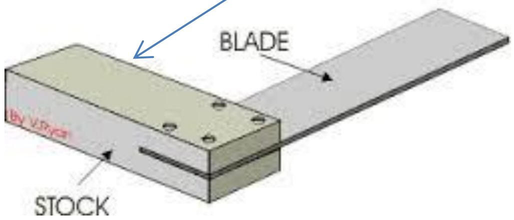
To make square fitting using cutting and filing process

Tools

1. Hack saw used for cutting the work piece
2. Bench vice used for holding the work piece
3. Files are used to simply rub and smoothen the surface
4. Try square for checking perpendicularity between two surfaces

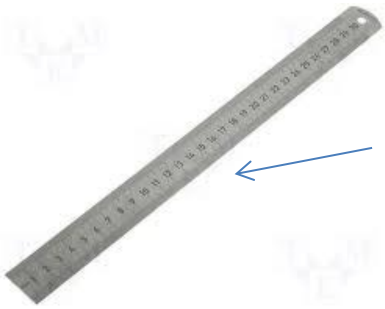
Bench vice

Try Square

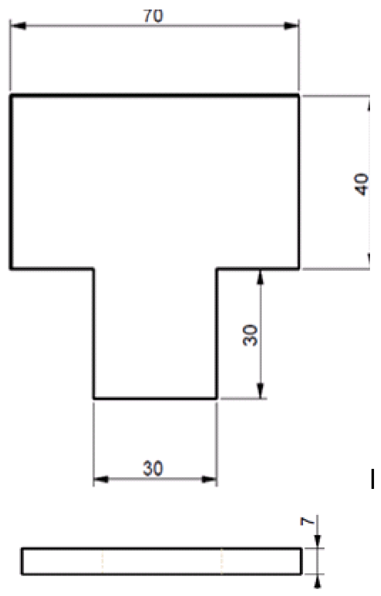


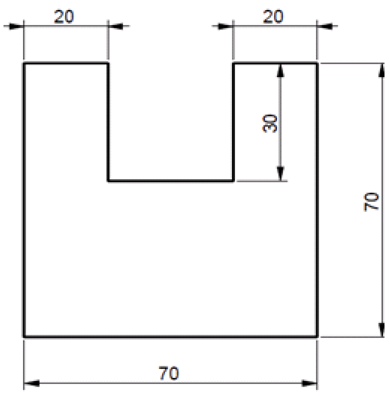
Different files

Hack Saw



Scale





Procedure

1. For the given material check the dimensions and cut it to the required dimension with allowance. Example: (for 70 mm cut it to the 73 mm)
2. Select the rough file rub the surface and smooth file at end for surface finishing
3. File the four sides of the work piece and make perfect rectangular shape
4. Use try square to check the perpendicularity between all surfaces
5. Mark the Square shape on the work piece
6. Using hacksaw cut the work piece in to two halves
7. Cut it to the required shape using hack saw
8. For the square shape use the knife edge file at the two corners
9. file the sides and make square fitting with close dimensional tolerance

Results

- Cutting & filing process is learnt and the square fitting is made on the work piece with close dimensional tolerance

Exp.No : 01(B)	Drilling & Tapping
Date :	

Drilling is a material cutting process in which a hole is made on the stationary work piece by the rotating drill bit Tapping is the process of creating thread on a drilled hole by tap tool

Objective

Objective is to make threaded hole on the work piece by drilling and tapping process

Tools

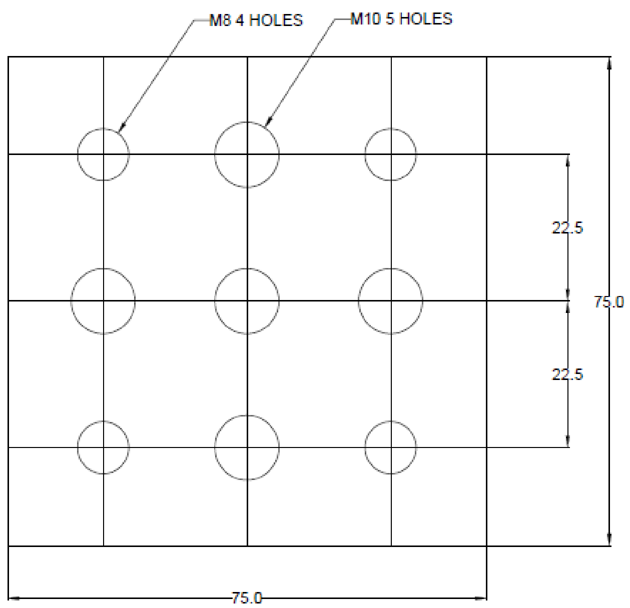
- Bench Drilling machine for making the holes
- Tap set for making threading inside the hole
- Tap set consists of First Second & Third tap
- Tap wrench for the holding the tap
- Drill bit is tool used in drilling machine for making the hole
- Scale & Marker
- Punch marking the hole position

Bench Drilling machine

Drill bits

Tap Wrench

Tap Set



ALL DIMENSIONS ARE IN MM

Procedure

1. For the given material check the dimensions and cut it to the required dimension with allowance. Example: (for 70 mm cut it to the 73 mm)
2. Select the rough file rub the surface and smooth file at end for surface finishing
3. File the four sides of the work piece and make perfect rectangular shape

4. Use try square to check the perpendicularity between all surfaces
5 Mark the hole location on the work piece
6 Using the punch make indentation
7 Place the work piece on the machine vise
8 select the center drill bit and hold in the drill chuck and lower it to make indentation
9 Select appropriate drill bit and hold it in drill chuck
10 Select proper speed and make the hole by lowering the handle
11 Remove the bur by filing process
12 Select appropriate tap tool of required dimension
13 Hold the tap tool in tap wrench (in the order 1,2,& 3) and manually make the thread

Results

Drilling and tapping process are learnt and threaded hole is made on the on the work piece with stated dimension.

Exp.No : 02 (A)	Familiarization of Electronic Components and Equipments
Date :	

Aim

To familiarize with various components required to build electronic circuits and equipment needed for measurement and characterization.

Components/Material

1. Resistors
2. Capacitors
3. Breadboard

Equipment

1. Power Supplies
2. Multi Meters
3. Function Generators
4. Digital Storage oscilloscope

Resistors

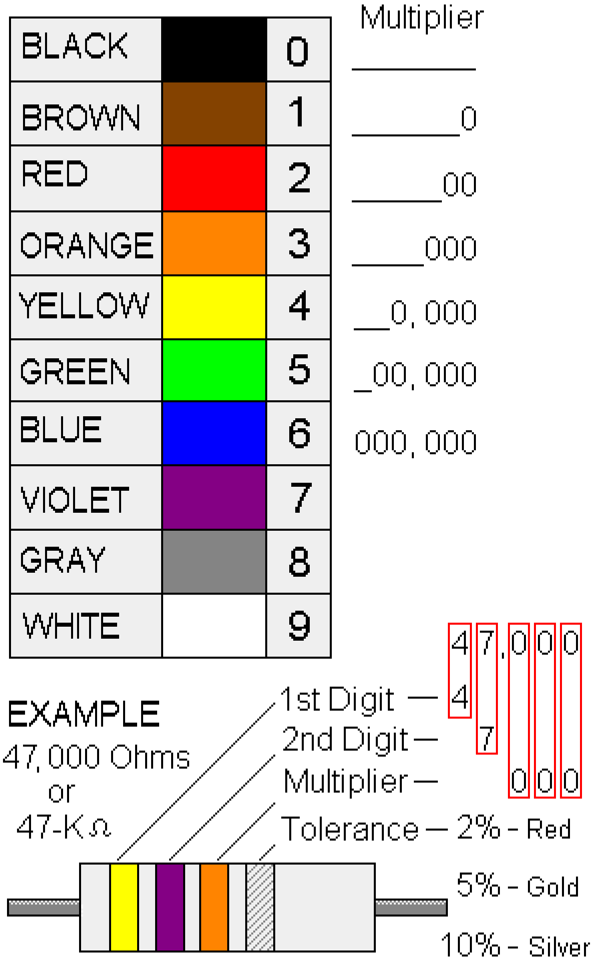
It is a two- terminal electronic component that produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law:

$$V = IR$$

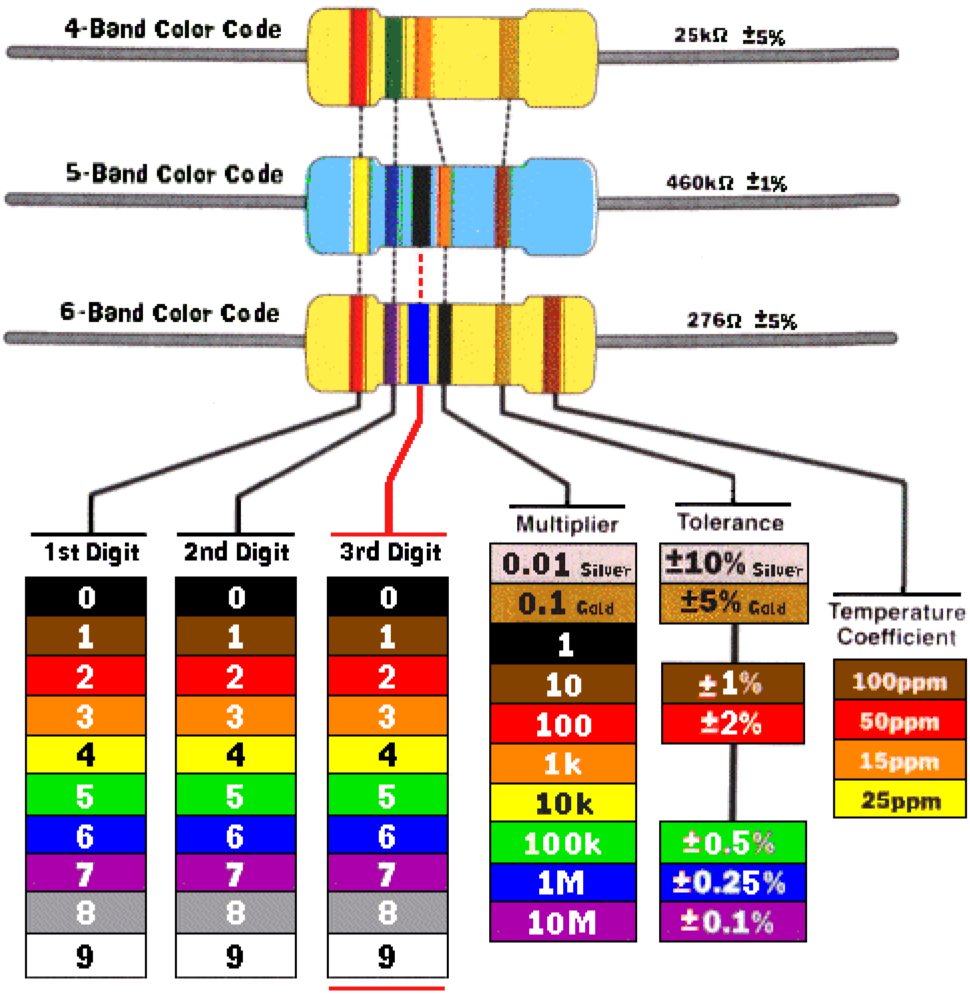
The purpose of a *resistor* is to provide a precise amount of electrical resistance in circuit.

Schematic symbol for a *resistor*:

Resistor Color Code



4 Band Color Code



Be Careful when reading 5 and 6 Band Resistors **Note:** the 3rd Digit is not used when reading the 4 band resistor

How to read Resistor Color Codes :

First the code

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Grey	White
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

The mnemonic

B B ROY of **G**reat **B**ritain has **V**ery **G**ood **W**ife.

Black is also easy to remember as zero because of the nothingness common to both.

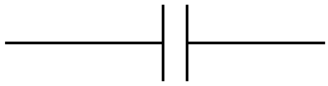
How to read the code

- First find the tolerance band, it will typically be gold (5%) and sometimes silver (10%).
- Starting from the other end, identify the first band - write down the number associated with that color; in this case Blue is 6.
- Now 'read' the next color, here it is red so write down a '2' next to the six. (you should have '62' so far.)
- Now read the third or 'multiplier exponent' band and write down that as the number of zeros.
- In this example it is two so we get '6200' or '6,200'. If the 'multiplier exponent' band is Black (for zero) don't write any zeros down.
- If the 'multiplier exponent' band is Gold move the decimal point one to the left. If the 'multiplier exponent' band is Silver move the decimal point two places to the left. If the resistor has one more band past the tolerance band it is a quality band.
- Read the number as the '% Failure rate per 1000 hour' This is rated assuming full wattage being applied to the resistors. (To get better failure rates, resistors are typically specified to have twice the needed wattage dissipation that the circuit produces). Some resistors use this band for temco information. 1% resistors have three bands to read digits to the left of the multiplier. They have a different temperature coefficient in order to provide the 1% tolerance.
- At 1% the temperature coefficient starts to become an important factor. at +/-200 ppm a change in temperature of 25 Deg C causes a value change of up to 1%

Capacitors :

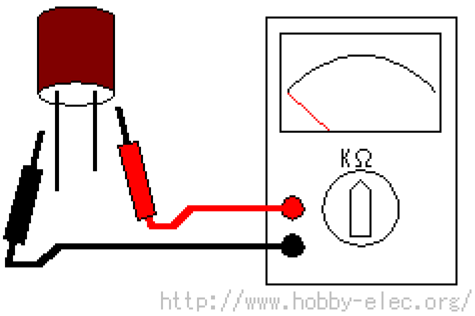
The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC).

Symbol of Capacitor:



The capacitor is constructed with two electrode plates facing each other, but separated by an insulator.

When DC voltage is applied to the capacitor, *an electric charge* is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor gets fully charged.



When a circuit tester, such as an analog meter set to measure resistance, is connected to a 10 microfarad (μF) electrolytic capacitor, a current will flow, but only for a moment. You can confirm that the meter's needle moves off of zero, but returns to zero right away.

When you connect the meter's probes to the capacitor in reverse, you will note that current once again flows for a moment. Once again, when the capacitor has fully charged, the current stops flowing. So the capacitor can be used as a filter that blocks DC current. (A "DC cut" filter.)

However, in the case of alternating current, the current will be allowed to pass. Alternating current is similar to repeatedly switching the test meter's probes back and forth on the capacitor. Current flows every time the probes are switched.

Identification of Capacitors

The value of a capacitor (the capacitance), is designated in units called the Farad (F). The capacitance of a capacitor is generally very small, so units such as the microfarad (10^{-6} F), nanofarad (10^{-9} F), and picofarad (10^{-12} F) are used. Electric Double Layer capacitor known as "Super Capacitors" has capacitance designated in Farad units.

Sometimes, a three-digit code is used to indicate the value of a capacitor. There are two ways in which the capacitance can be written.

(i) Using letters and numbers.

(ii) Using only numbers.

In either case, there are only three characters used. The method used differs depending on the capacitor supplier. In the case that the value is displayed with the three-digit code, the 1st and 2nd digits from the left show the 1st figure and the 2nd figure, and the 3rd digit is a multiplier which determines how many zeros are to be added to the capacitance. Pico farad (pF) units are written this way. This is given in the table below.

Third digit	Multiplier (this times the first two digits gives you the value in Pico-Farads)
0	1
1	10
2	100
3	1,000
4	10,000
5	100,000
6 not used	
7 not used	
8	.01
9	.1

For example, when the code is [103], it indicates 10 x 10^3, or 10,000 pF = 10 nanofarad (nF) = 0.01 microfarad (µf). Thus [10n] and [103] denote the same value of capacitance. If the code happened to be [224], it would be 22 x 10^4 = or 220,000 pF = 220 nF= 0.22 µF. Values under 100pF are displayed with 2 digits only. For example, 47 would be 47pF. Sometimes a tolerance code is given by a single letter. So a 103J is a 10,000 pF with +/- 5% tolerance

Letter symbol	Tolerance of capacitor
D	+/- 0.5 pF
F	+/- 1%
G	+/- 2%
H	+/- 3%
J	+/- 5%
K	+/- 10%
M	+/- 20%
P	+100% ,-0%
Z	+80%, -20%

Type of Capacitors:

Electrolytic Capacitors (Electrochemical type capacitors)

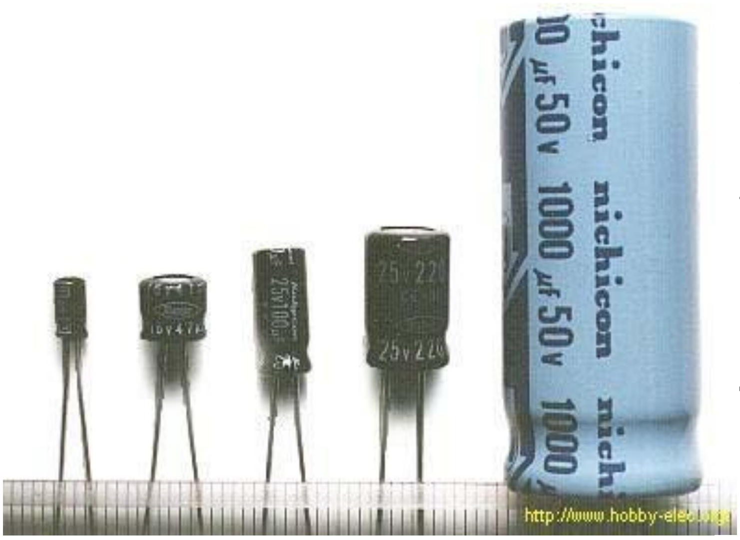
An **electrolytic capacitor** is a type of capacitor that uses an ionic conducting liquid as one of its plates with a larger capacitance per unit volume than other types. They are valuable in relatively high-current and low-frequency electrical circuits. This is especially the case in power-supply filters, where they store charge needed to moderate output voltage and current fluctuations in rectifier output. They are also widely used as coupling capacitors in circuits where ac should be conducted but dc should not.

Aluminum electrolytic capacitors are constructed from two conducting aluminum foils, one of which is coated with an insulating oxide layer, and a paper spacer soaked in electrolyte. The foil insulated by the oxide layer is the anode while the liquid electrolyte and the second foil act as cathode. This stack is then rolled up, fitted with pin connectors and placed in a cylindrical aluminum casing. The two most popular geometries are axial leads coming from the center of each circular face of the cylinder, or two radial leads or legs on one of the circular faces. Both of these are shown in the picture.

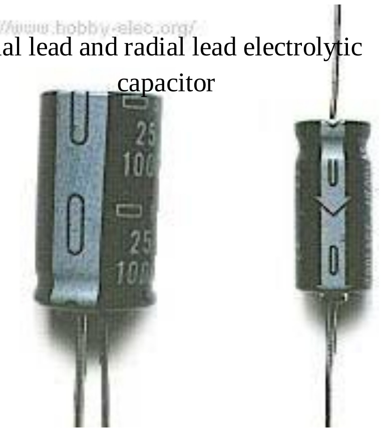
The most important characteristic of electrolytic capacitors is that they have polarity. They have a positive and a negative electrode. This means that it is very important which way round they are connected. **If the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst.** It is extremely dangerous, because it can quite literally explode. **Make absolutely no mistakes.**

Generally, in the circuit diagram, the positive side is indicated by a "+" (plus) symbol. Electrolytic capacitors range in value from about 1µF to thousands of µF. Mainly this type of capacitor is used as a ripple filter in a power supply circuit, or as a filter to bypass low frequency signals, etc. Because this type of capacitor is comparatively similar to the nature of a coil in construction, it isn't possible to use for high-frequency circuits.

The photograph on the left is an example of the different values of electrolytic capacitors in which the capacitance and voltage differ.



From the left to right:
1µF (50V) [dia. 5 mm, ht. 12 mm]
47µF (16V) [dia. 6 mm, ht 5 mm]
100µF (25V) [dia. 5 mm, ht 11 mm]
220µF (25V) [dia. 8 mm, ht 12 mm]
1000µF(50V) [dia.18 mm, ht.40mm]
The size of the capacitor sometimes depends on the manufacturer. So the sizes shown here are just **examples**.



Axial lead and radial lead electrolytic capacitor

In the photograph to the right (above), the mark indicating the negative lead of the component can be seen. You need to pay attention to the polarity indication so as not to make a mistake when you assemble the circuit.

Tantalum Capacitors

Tantalum Capacitors are electrolytic capacitors that use a material called tantalum for the electrodes. Large values of capacitance similar to aluminum electrolytic capacitors can be obtained. Also, tantalum capacitors are superior to aluminum electrolytic capacitors in temperature and frequency characteristics. When tantalum powder is baked in order to solidify it, a crack forms inside. An electric charge can be stored on this crack. These capacitors have polarity as well. Usually, the "+" symbol is used to show the positive component lead. Do not make a mistake with the polarity on these types. Tantalum capacitors are a little bit more expensive than aluminum electrolytic capacitors. Capacitance can change with temperature as well as frequency, and these types are very stable. Therefore, tantalum capacitors are used for circuits which demand high stability in the capacitance values. Also, it is said to be common sense to use tantalum capacitors for analog signal systems, because the current-spike noise that occurs with aluminum electrolytic capacitors does not appear. Aluminum electrolytic capacitors are fine if you don't use them for circuits which need the high stability characteristics of tantalum capacitors.

The photograph on the left illustrates the tantalum
0.33 µF (35V)
0.47 µF (35V)
10 µF (35V)

The "+" symbol is used to show the positive lead of the component. It is written on the body.

Ceramic Capacitors

Ceramic capacitor is constructed of alternating layers of metal and ceramic, with the ceramic material acting as the dielectric. Ceramic capacitors are constructed with materials such as titanium acid barium used as the dielectric. Internally, these capacitors are not constructed as a coil, so they can be used in high frequency applications. Typically, they are used in circuits which bypass high frequency signals to ground.

These capacitors have the shape of a disk. Their capacitance is comparatively small. The capacitor on the left is a 100pF capacitor with a diameter of about 3 mm. The capacitor on the right side is printed with 103, so 10 x 10^3 pF becomes 0.01 µF. The diameter of the disk is about 6 mm.

Ceramic capacitors have no polarity. Ceramic capacitors should not be used for analog circuits, because they can distort the signal as they often has high dissipation factor or high frequency coefficient of dissipation.

Multilayer Ceramic Capacitors

The multilayer ceramic capacitor has a many-layered dielectric. These capacitors are small in size, and have good temperature and frequency characteristics. Square wave signals used in digital circuits can have a comparatively high frequency component included. This capacitor is used to bypass the high frequency to ground.

In the photograph, the capacitance of the component on the left is displayed as 104. So, the capacitance is 10 x 10^4 pF = 0.1 µF. The thickness is 2 mm, the height is 3 mm, the width is 4 mm. The capacitor to the right has a capacitance of 103 (10 x 10^3 pF = 0.01 µF). The height is 4 mm, the diameter of the round part is 2 mm. These capacitors have no polarity.

Polystyrene Film Capacitors

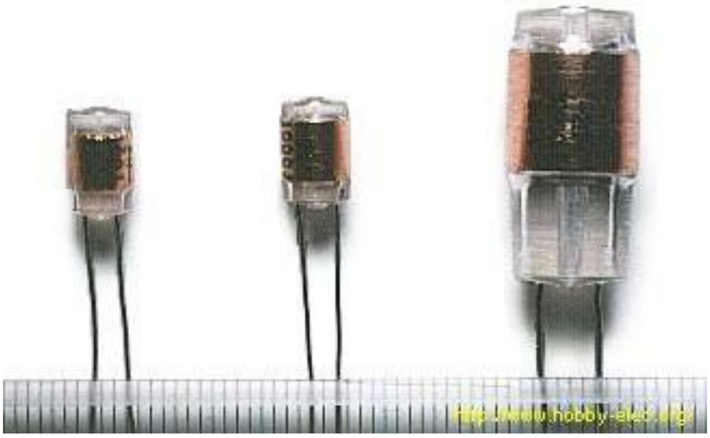
In these devices, polystyrene film is used as the dielectric. This type of capacitor is not for use in high frequency circuits, because they are constructed like a coil inside. They are used well in filter circuits or timing circuits which run at several hundred KHz or less.

The component shown on the left has a red color due to the copper leaf used for the electrode. The silver color is due to the use of aluminum foil as the electrode.

The device on the left has a height of 10 mm, is 5 mm thick, and is rated 100pF. The device in the middle has a height of 10 mm, 5.7 mm thickness, and is rated 1000pF. The device on the right has a height of 24 mm, is 10 mm thick, and is rated 10000pF. These devices have no polarity.

Electric DoubleLayerCapacitors (Super Capacitors)

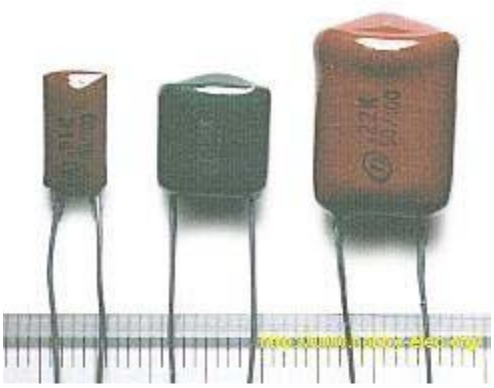
This is a "Super Capacitor," which is quite a wonder. The capacitance is 0.47 F (470,000 µF). Care must be taken when using a capacitor with such a large capacitance in power supply circuits, etc.



The rectifier in the circuit can be destroyed by a huge rush of current when the capacitor is empty. For a brief moment, the capacitor is more like a short circuit. A protection circuit needs to be set up. The size is small in spite of capacitance. Physically,

the diameter is 21 mm, the height is 11 mm. Care is necessary, because these devices do have polarity.

Polyester Film Capacitors



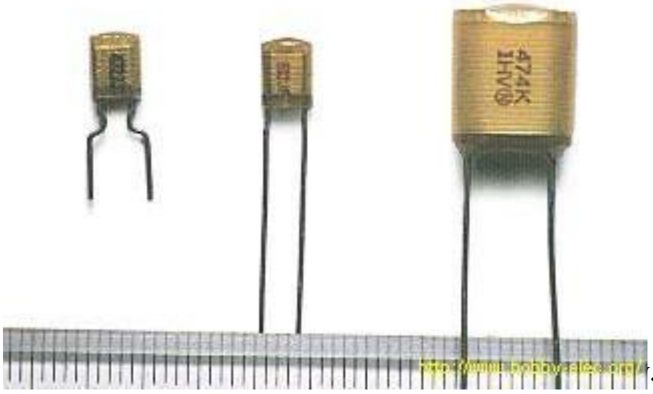
This capacitor uses thin polyester film as the dielectric. They are not high tolerance, but they are cheap and handy. Their tolerance is about ±5% to ±10%. From the left in the photograph

Capacitance: 0.001 µF (printed with 001K) [width 5 mm, height 10 mm, thickness 2 mm]

Capacitance: 0.1 µF (printed with 104K) [width 10 mm, height 11 mm, thickness 5mm]

Capacitance: 0.22 µF (printed with .22K) [width 13 mm, height 18 mm, thickness 7mm]

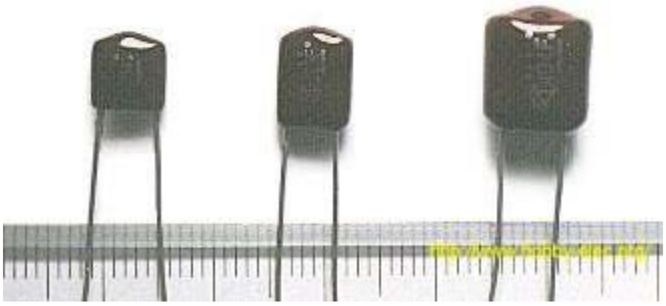
Care must be taken, because different manufacturers use different methods to denote the capacitance values.



Here are some other polyester film capacitors. Starting from the left Capacitance: 0.0047 µF (printed with 472K) [width 4mm, height 6mm, thickness 2mm] Capacitance: 0.0068 µF (printed with 682K) [width 4mm, height 6mm, thickness 2mm] Capacitance: 0.47 µF (printed with 474K) [width 11mm, the height 14mm, .

Polypropylene Capacitors

This capacitor is used when a higher tolerance is necessary than polyester capacitors offer. Polypropylene film is used for the dielectric. It is said that there is almost no change of capacitance in these devices if they are used with frequencies of 100KHz or less. The pictured capacitors have a tolerance of ±1%.



From the left in the photograph

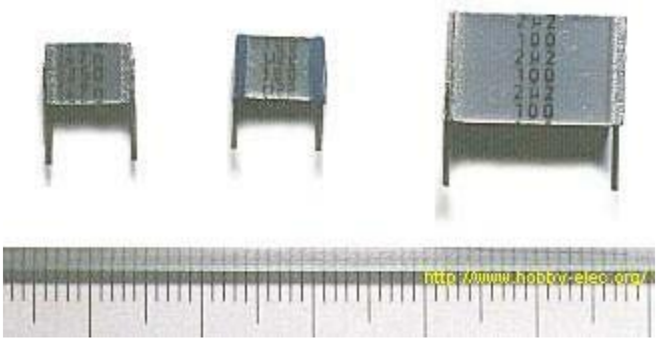
Capacitance: 0.01 µF (printed with 103F) [width 7mm, height 7mm, thickness 3mm]
Capacitance: 0.022 µF (printed with 223F) [width 7mm, height 10mm, thickness 4mm]
Capacitance: 0.1 µF (printed with 104F) [width 9mm, height 11mm, thickness 5mm] Please try to observe the error in the measured values of capacitances from the actual specified values. These capacitors have no polarity.

Mica Capacitors

These capacitors use Mica for the dielectric. Mica capacitors have good stability because their temperature coefficient is small. Because their frequency characteristic is excellent, they are used for resonance circuits, and high frequency filters. Also, they have good insulation, and so can be utilized in high voltage circuits. It was often used for vacuum tube style radio transmitters, etc. Mica capacitors do not have high values of capacitance, and they can be relatively expensive.

Pictured at the right are "Dipped mica capacitors." These can handle up to 500 volts. The capacitance from the left Capacitance: 47pF (printed with 470J) [width 7mm, height 5mm, thickness 4mm] Capacitance: 220pF (printed with 221J) [width 10mm, height 6mm, thickness 4mm] Capacitance: 1000pF (printed with 102J) [width 14mm, height 9mm, thickness 4mm] These capacitors have no polarity.

Metalized Polyester Film Capacitors



These capacitors are a kind of a polyester film capacitor. Because their electrodes are thin, they can be miniaturized.

From the left in the photograph Capacitance: 0.001µF (printed with 1n. n means nano:10^{-9}) Breakdown voltage: 250V [width 8mm, height 6mm, thickness 2mm] Capacitance: 0.22µF (printed with u22) Breakdown voltage: 100V [width 8mm, height 6mm, thickness 3mm] Capacitance: 2.2µF (printed with 2u2) Breakdown voltage: 100V [width 15mm, height

10mm, thickness 8mm] Care is necessary, because the component lead easily breaks off from these capacitors. Once lead has come off, there is no way to fix it. It must be discarded. These capacitors have no polarity.

VariableCapacitors

Variable capacitors are used for adjustment etc. of frequency mainly.

On the left in the photograph is a "trimmer," which uses ceramic as the dielectric. Next to it on the right is one that uses polyester film for the dielectric. The pictured components are meant to be mounted on a printed circuit board.

When adjusting the value of a variable capacitor, it is advisable to be careful. One of the component's leads is connected to the adjustment screw of the capacitor. This means that the value of the capacitor can be affected by the capacitance of the screwdriver in your hand. It is better to use a special screwdriver to adjust these components.

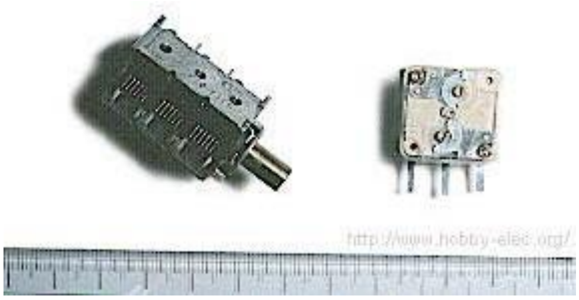
Pictured in the upper left photograph are variable capacitors with the following specifications:

Capacitance: 20pF (3pF - 27pF measured) [Thickness 6 mm, height 4.8 mm]

There are different colors, as well. Blue: 7pF (2 - 9), white: 10pF (3 - 15), green: 30pF (5 - 35), brown: 60pF (8 - 72).

In the same photograph, the device on the right has the following specifications: Capacitance: 30pF (5pF - 40pF measured)

[The width (long) 6.8 mm, width (short) 4.9 mm, and the height 5 mm]



The components in the photograph on the right are used for radio tuners, etc. They are called "Varicons" but this may be only in Japan.

The variable capacitor on the left in the photograph, uses air as the dielectric. It combines three independent capacitors.

For each one, the capacitance changed 2pF - 18pF. When the adjustment axis is turned, the capacitance of all 3 capacitors change simultaneously. Physically, the device has a depth of 29 mm, and 17 mm width and height. (Not including the adjustment rod.)

There are various kinds of variable capacitor, chosen in accordance with the purpose for which they are needed. The pictured components are very small.

To the right in the photograph is a variable capacitor using polyester film as the dielectric. Two independent capacitors are combined.

The capacitance of one side changes 12pF - 150pF, while the other side changes from 11pF - 70pF. Physically, it has a depth of 11mm, and 20mm width and height. (Not including the adjustment rod.)

The pictured device also has a small trimmer built in to each capacitor to allow for precise adjustment up to 15pF.

COMPONENT LOOK-UP TABLES

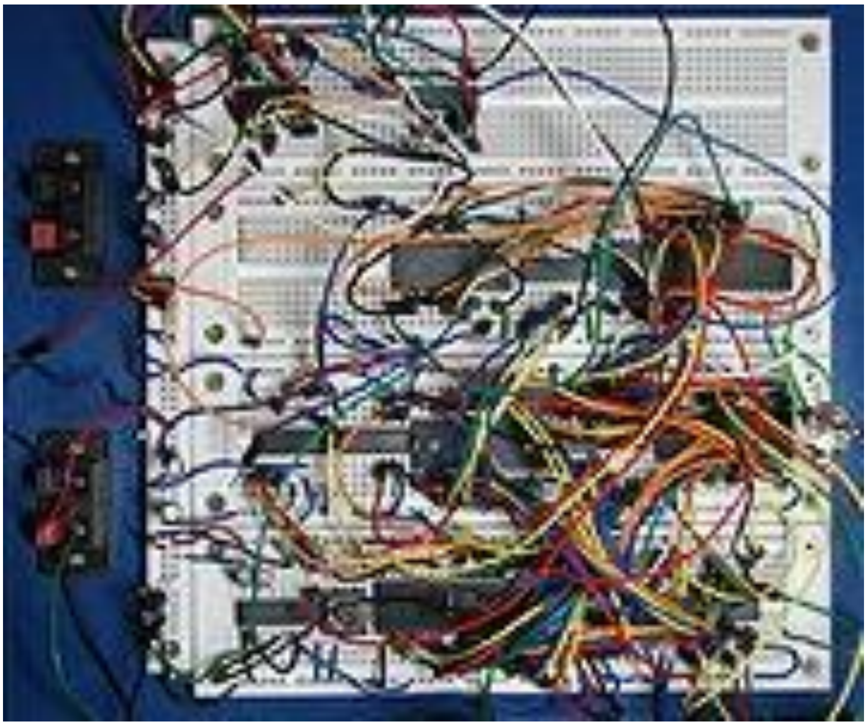
Standard Capacitor Values

1 pF	7.5 pF	56 pF	470 pF	3600 pF	0.47 µF	2200 µF
1.1 pF	8.2 pF	62 pF	510 pF	3900 pF	0.68 µF	3300 µF
1.2 pF	9.1 pF	68 pF	560 pF	4300 pF	1.0 µF	4700 µF
1.3 pF	10 pF	75 pF	620 pF	4700 pF	1.5 µF	6800 µF
1.5 pF	11 pF	82 pF	680 pF	5100 pF	2.2 µF	10000 µF
1.6 pF	12 pF	91 pF	750 pF	5600 pF	3.3 µF	
1.8 pF	13 pF	100 pF	820 pF	6200 pF	4.7 µF	
2.0 pF	15 pF	110 pF	910 pF	6800 pF	6.8 µF	
2.2 pF	16 pF	120 pF	1000 pF	7500 pF	10 µF	
2.4 pF	18 pF	130 pF	1100 pF	8200 pF	15 µF	
2.7 pF	20 pF	150 pF	1200 pF	9100 pF	22 µF	
3.0 pF	22 pF	160 pF	1300 pF	0.01 µF	33 µF	
3.3 pF	24 pF	180 pF	1500 pF	0.015 µF	47 µF	
3.6 pF	27 pF	200 pF	1600 pF	0.022 µF	68 µF	
3.9 pF	30 pF	220 pF	1800 pF	0.033 µF	100 µF	
4.3 pF	33 pF	240 pF	2000 pF	0.047 µF	150 µF	
4.7 pF	36 pF	270 pF	2200 pF	0.068 µF	220 µF	
5.1 pF	39 pF	300 pF	2400 pF	0.1 µF	330 µF	
5.6 pF	43 pF	360 pF	2700 pF	0.15 µF	470 µF	
6.2 pF	47 pF	390 pF	3000 pF	0.22 µF	680 µF	
6.8 pF	51 pF	430 pF	3300 pF	0.33 µF	1000 µF	

PROTOTYPE BOARD (BREADBOARD)

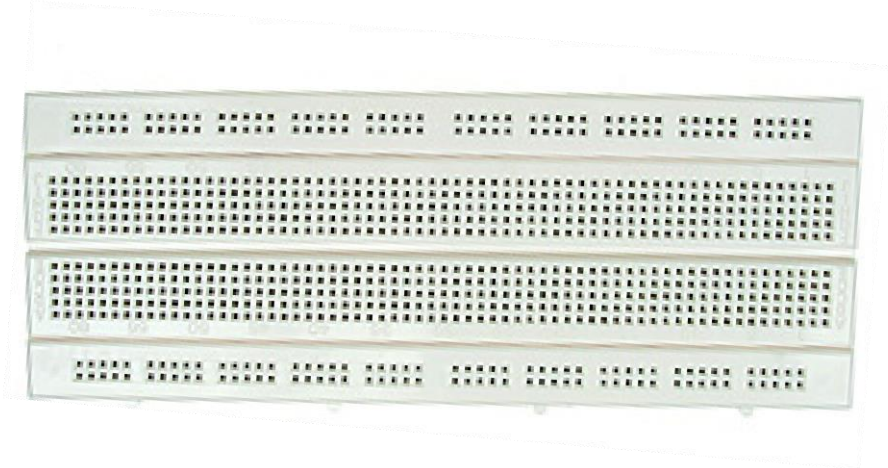
A **breadboard** (**protoboard**) is a construction base for an electronic circuit. In modern times the term is commonly used to refer to a particular type of breadboard, the **solderless breadboard** (**plugboard**). This is a typical bread board or prototype board used to make the temporary circuits. The solderless breadboard has, despite that it doesn't require soldering, the additional property that it is reusable, and thus can be used for temporary prototypes and experimenting with circuit design more easily. Other, often historic, breadboard types don't have this property. This is also in contrast to stripboard (veroboard) and similar prototyping printed circuit boards, which are used to build more permanent soldered prototypes or one- offs, and cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

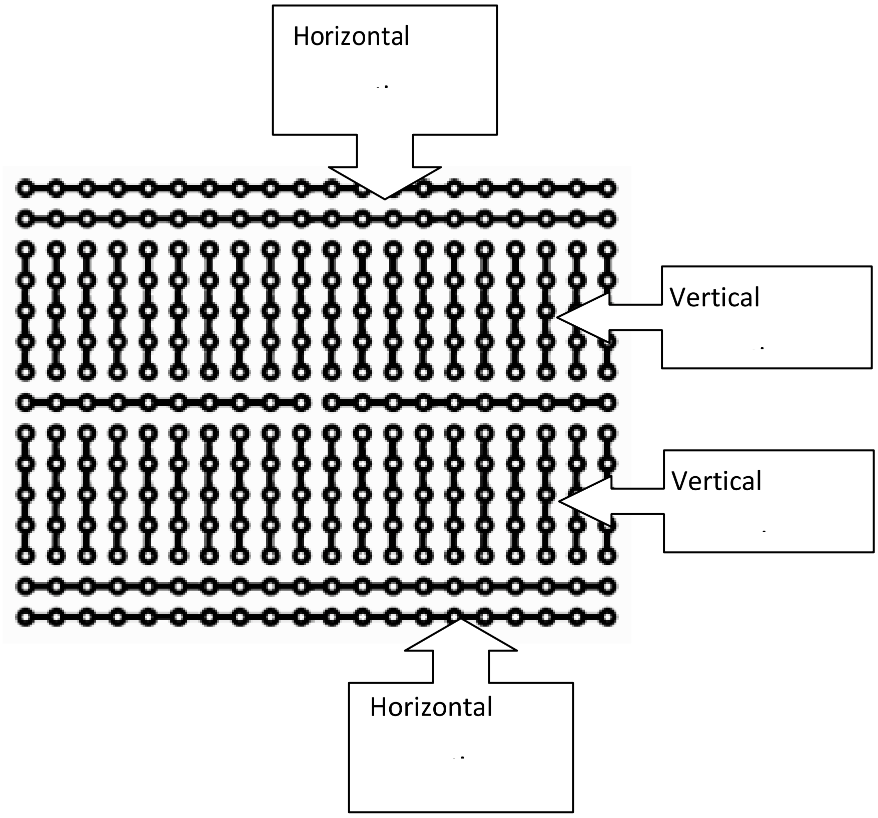
The term breadboard is derived from an early form of point-to-point construction: in particular, the practice of constructing simple circuits (usually using valves/tubes) on a convenient wooden base, similar to a cutting board like the kind used for slicing bread with a knife.



An example of a complex circuit built on a breadboard. The circuit is an Intel 8088 single board computer.

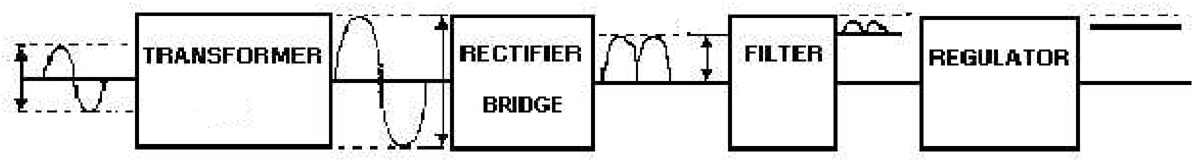
Breadboard and its connections are shown below.





EQUIPMENTS

POWER SUPPLIES :



Block diagram of a basic power supply.

As illustrated in view of figure, the first section is the TRANSFORMER. The transformer steps up or steps down the input line voltage and isolates the power supply from the power line. The RECTIFIER section converts the alternating current input signal to a pulsating direct current. For this reason a FILTER section is used to convert pulsating dc to a purer, more desirable form of dc voltage. The Regulator circuit is used to give the constant voltage at the output terminals.

Front panel Diagram of PSD series DC multiple power supply

Features:

Voltage range (0-30 V, ±15 V, 5 V)
Constant voltage and constant current protection
Digital display for voltage and current
Adjustable current limiter
Protection against over load and Short circuit
Compact and light weight

MULTIMETER:

In a Digital Multimeter the signal under test is converted to a voltage and an amplifier with an electronically controlled gain preconditions the signal. A Digital Multimeter displays the quantity measured as a number, which prevents parallax errors. The inclusion of solid state electronics, from a control circuit to small embedded computers, has provided a wealth of convenience features in modern digital meters. Commonly available measurement enhancements include:

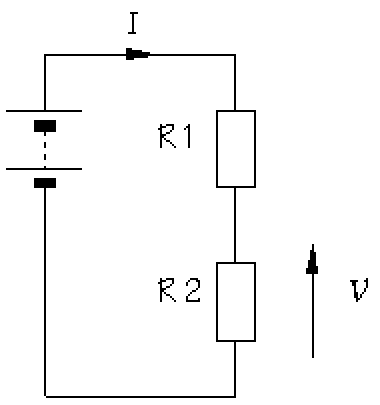
Auto-ranging, which selects the correct range for the quantity under test so that the most significant digits are shown. For example, a four-digit multimeter would automatically select an appropriate range to display 1.234 instead of 0.012, or overloading. Auto-ranging meters usually include a facility to 'freeze' the meter to a particular range, because a measurement that causes frequent range changes is distracting to the user.

- Auto-polarity for direct-current readings, shows if the applied voltage is positive (agrees with meter lead labels) or negative (opposite polarity to meter leads).
- Sample and hold, which will latch the most recent reading for examination after the instrument is removed from the circuit under test.
- Current-limited tests for voltage drop across semiconductor junctions. While not a replacement for a transistor tester, this facilitates testing diodes and a variety of transistor types.
- A graphic representation of the quantity under test, as a bar graph. This makes go/no-go testing easy, and also allows spotting of fast-moving trends.
- A low-bandwidth oscilloscope.
- Automotive circuit testers, including tests for automotive timing and dwell signals.
- Simple data acquisition features to record maximum and minimum readings over a given period, or to take a number of samples at fixed intervals
- Integration with tweezers for surface-mount technology.
- A combined LCR meter for small-size SMD and through-hole components.

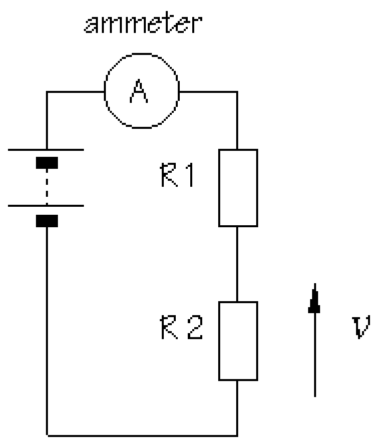
A meter is a measuring instrument. An **ammeter** measures current, a **voltmeter** measures the potential difference (voltage) between two points, and an **ohmmeter** measures resistance. A **multimeter** combines these functions and possibly some additional ones as well, into a single instrument.

Before going in to detail about multimeters, it is important for you to have a clear idea of how meters are connected into circuits. Diagrams *A* and *B* below show a circuit before and after connecting an ammeter:

A



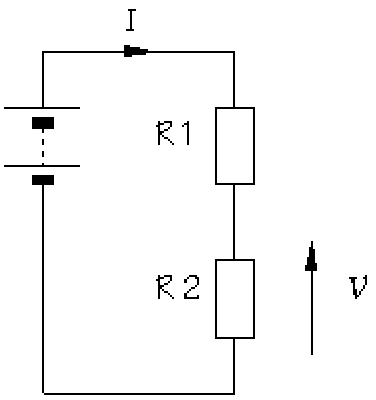
B



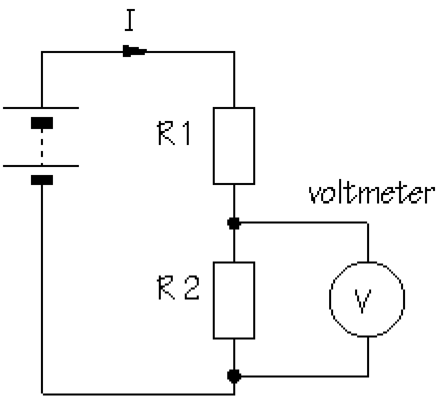
To measure current circuit must be broken to allow the ammeter to be connected in series Ammeter must have a Low resistance

Think about the changes you would have to make to a practical circuit in order to include the ammeter. To start with, you need to *break the circuit* so that the ammeter can be connected in series. All the current flowing in the circuit must pass through the ammeter. Meters are not supposed to alter the behavior of the circuit, or at least not significantly, and it follows that an ammeter must have a very LOW resistance.

A



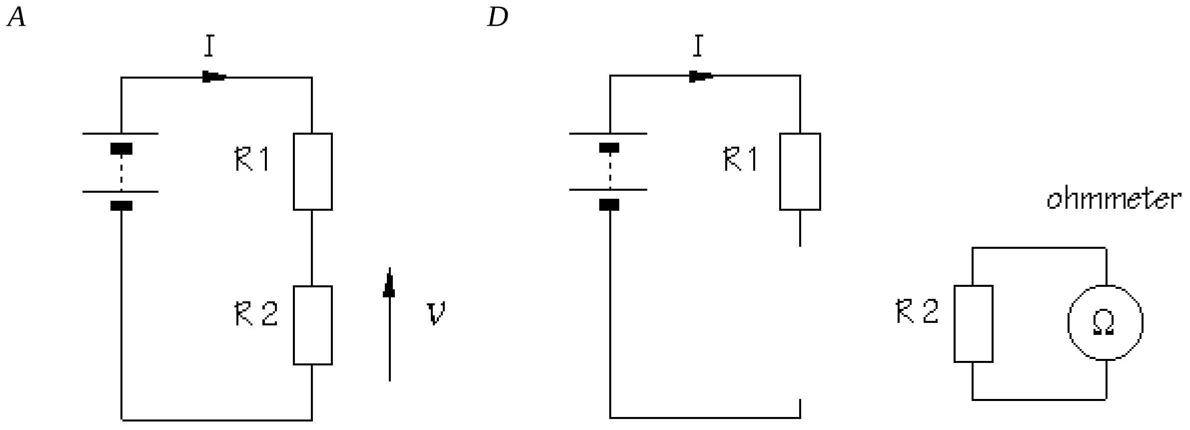
C



To Measure potential difference (voltage), the circuit is not changed and the voltmeter is connected in parallel. Voltmeter must have a HIGH resistance.

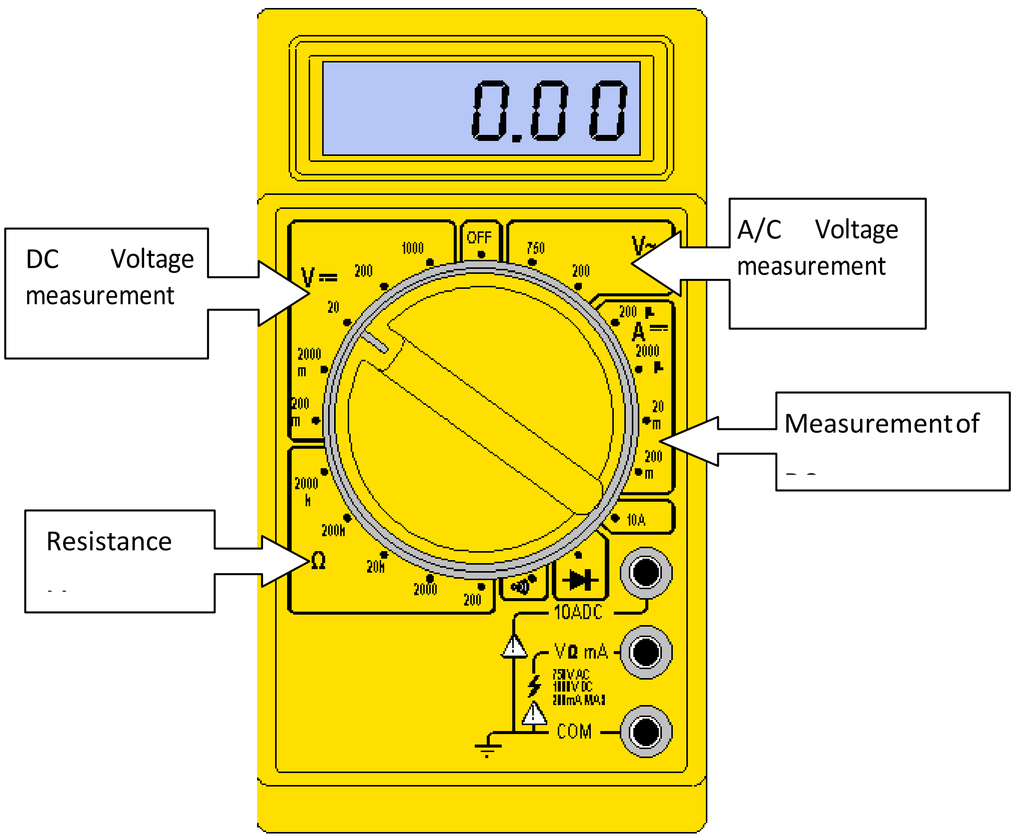
This time, you do not need to break the circuit. The voltmeter is connected in parallel between the two points where the measurement is to be made. Since the voltmeter provides a parallel pathway, it should take as little current as possible. In other words, a voltmeter should have a very HIGH resistance.

Which measurement technique do you think will be the more useful? In fact, voltage measurements are used much more often than current measurements. The processing of electronic signals is usually thought of in voltage terms. It is an added advantage that a voltage measurement is easier to make. The original circuit does not need to be changed. Often, the meter probes are connected simply by touching them to the points of interest.
An ohmmeter does not function with a circuit connected to a power supply. If you want to measure the resistance of a particular component, you must take it out of the circuit altogether and test it separately, as shown in diagram *D*:



To measure resistance, the component must be removed from the circuit altogether. Ohmmeters work by passing a small current through the component and measuring the voltage produced. If you try this with the component connected into a circuit with a power supply, the most likely result is that the meter will be damaged. Most multimeters have a fuse to help protect against misuse.

Front panel Diagram of a typical Digital multimeter:



FUNCTION GENERATORS:

Analog function generators usually generate a triangular waveform as the basis for all of its other outputs. The triangle is generated by repeatedly charging and discharging a capacitor from a constant current source. This produces a linearly ascending or descending voltage ramp. As the output voltage reaches upper and lower limits, the charging and discharging is reversed using a comparator, producing the linear triangle wave. By varying the current and the size of the capacitor, different frequencies may be obtained.

A 50% duty cycle square wave is easily obtained by noting whether the capacitor is being charged or discharged, which is reflected in the current switching comparator's output. Most function generators also contain a non-linear diode shaping circuit that can convert the triangle wave into a reasonably accurate sine wave. It does so by rounding off the hard corners of the triangle wave in a process similar to clipping in audio systems.

The type of output connector from the device depends on the frequency range of the generator. A typical function generator can provide frequencies up to 20 MHz and uses a BNC connector, usually requiring a 50 or 75 ohm termination. Specialised RF generators are capable of gigahertz frequencies and typically use N-type output connectors. The **N connector** (in full, **Type N connector**) is a threaded RF connector used to join coaxial cables. It was invented in the 1940s by Paul Neill of Bell Labs, after whom the connector is named.

Function generators, may also contain an attenuator, various means of modulating the output waveform, and often the ability to automatically and repetitively "sweep" the frequency of the output waveform (by means of a voltage controlled oscillator) between two operator-determined limits. This capability makes it very easy to evaluate the frequency response of a given electronic circuit.

Features and Control

Most function generators allow the user to choose the shape of the output from a small number of options.

- Square wave - The signal goes directly from high to low voltage.
- Sine wave - The signal curves like a sinusoid from high to low voltage.
- Triangle wave - The signal goes from high to low voltage at a fixed rate.

The amplitude control on a function generator varies the voltage difference between the high and low voltage of the output signal.

The direct current (DC) offset control on a function generator varies the average voltage of a signal relative to the ground.

The frequency control of a function generator controls the rate at which output signal oscillates. On some function generators, the frequency control is a combination of different controls. One set of controls chooses the broad frequency range (order of magnitude) and the other selects the precise frequency. This allows the function generator to handle the enormous variation in frequency scale needed for signals.

The duty cycle of a signal refers to the ratio of high voltage to low voltage time in a square wave signal.

How to use the Function Generators:

After powering on the function generator, the output signal needs to be configured to the desired shape. Typically, this means connecting the signal and ground leads to an oscilloscope to check the controls. Adjust the function generator until the output signal is correct, then attach the signal and ground leads from the function generator to the input and ground of the device under test. For some applications, the negative lead of the function generator should attach to a negative input of the device, but usually attaching to ground is sufficient.

Front panel Diagram of the function Generator:

SGDA 80M 80 MHz Function Generator

Features :

- Three functions in one instruments
- Function Generator
- Sweep Generator
- Frequency Counter
- Waveforms : Sine, Square, Triangle,
- Ramp, Pulse, adjustable DC
- DC- Offset Adjustment
- External Modulation AM(standard & Balanced) FM , PWM, PAM
- Internal Sweep
- Distortion Factor < 0.5%
- Square Wave rise time typ. 40ns
- All the parameters can be remotely controlled via RS232 interface

DIGITAL STORAGE OSCILLOSCOPE:

The **digital storage oscilloscope**, or DSO for short, is now the preferred type for most industrial applications, although simple analog CROs are still used by hobbyists. It replaces the unreliable storage method used in analog storage scopes with digital memory, which can store data as long as required without degradation. It also allows complex processing of the signal by high-speed digital signal processing circuits.

The vertical input, instead of driving the vertical amplifier, is digitized by an analog to digital converter to create a data set that is stored in the memory of a microprocessor. The data set is processed and then sent to the display, which in early DSOs was a cathode ray tube, but is now more likely to be an LCD flat panel. DSOs with color LCD displays are common. The data set can be sent over a LAN or a WAN for processing or archiving. The screen image can be directly recorded on paper by means of an attached printer or plotter, without the need for an oscilloscope camera. The scope's own signal analysis software can extract many useful time-domain features (e.g. rise time, pulse width, amplitude), frequency spectra, histograms and statistics, persistence maps, and a large number of parameters meaningful to engineers in specialized fields such as telecommunications, disk drive analysis and power electronics.

Digital oscilloscopes are limited principally by the performance of the analog input circuitry and the sampling frequency. In general, the sampling frequency should be at least the Nyquist rate, double the frequency of the highest-frequency component of the observed signal, otherwise aliasing may occur.

Digital storage also makes possible another unique type of oscilloscope, the equivalent-time sample scope. Instead of taking consecutive samples after the trigger event, only one sample is taken. However, the oscilloscope is able to vary its time base to precisely time its sample, thus building up the picture of the signal over the subsequent repeats of the signal. This requires that either a clock or repeating pattern be provided. This type of scope is frequently used for very high speed communication because it allows for a very high "sample rate" and low amplitude noise compared to traditional real-time scopes.

To sum this up: Advantages over the analog oscilloscope:

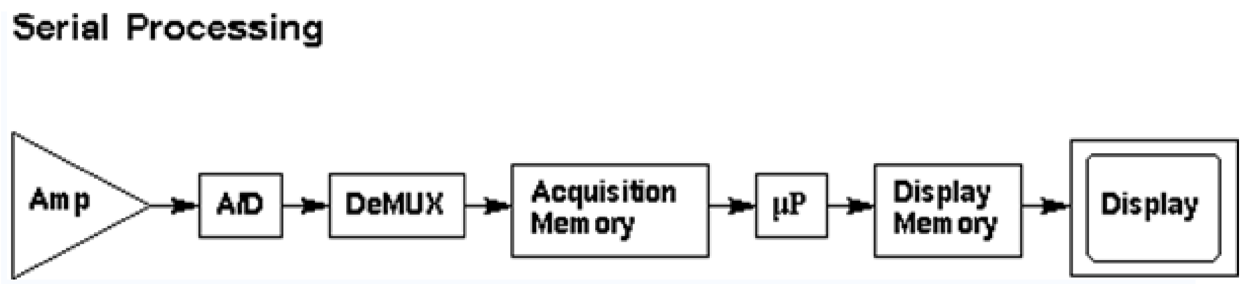
- Brighter and bigger display with color to distinguish multiple traces
- Equivalent time sampling and Average across consecutive samples or scans lead to higher resolution down to µV
- Peak detection
- Pre-trigger (events before the trigger occurs can be displayed)
- Easy pan and zoom across multiple stored traces allows beginners to work without a trigger
    - This needs a fast reaction of the display (some scopes have 1 ms delay)
    - The knobs have to be large and turn smoothly
- Also slow traces like the temperature variation across a day can be recorded
- The memory of the oscilloscope can be arranged not only as a one-dimensional list but also as a two-dimensional array to simulate a phosphor screen. The digital technique allows a quantitative analysis
- A disadvantage of digital oscilloscopes is the limited refresh rate of the screen. On an analog oscilloscope, the user can get an intuitive sense of the trigger rate simply by looking at the steadiness of the CRT trace. For a digital oscilloscope, the screen looks exactly the same for any signal rate which exceeds the screen's refresh rate. Additionally, it is sometimes hard to spot "glitches" or other rare phenomena on the black-and-white screens of standard digital oscilloscopes; the slight persistence of CRT phosphors on analog scopes makes glitches visible even if many subsequent triggers overwrite them. Both of these difficulties have been overcome recently by "digital phosphor oscilloscopes," which store data at a very high refresh rate and display it with variable intensity, to simulate the trace persistence of a CRT scope.

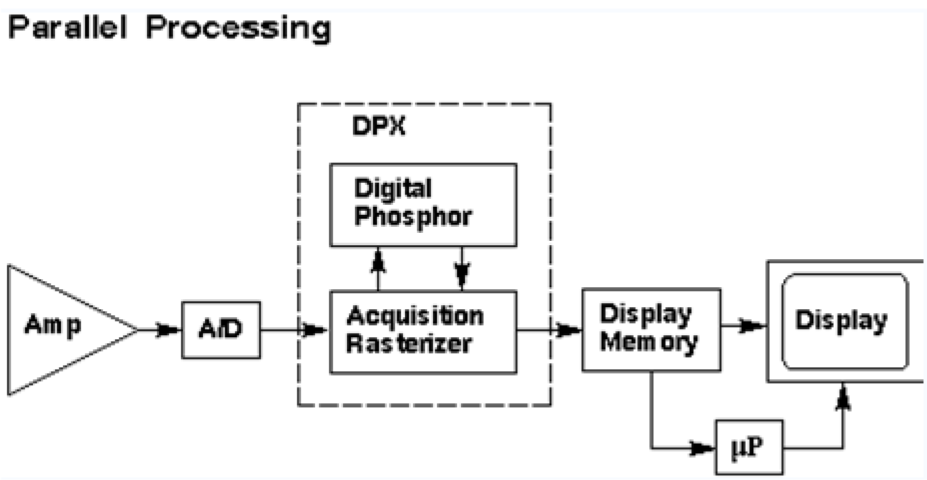
- A related type of analog sampling 'scope for displaying very fast, repetitive waveforms sampled very quickly (fractional nanoseconds) and held the samples long enough to be displayed by a narrow-band vertical amplifier and a modest-performance CRT. A comparatively slow sweep on the CRT corresponded with progressive tiny advancing sample times, so that many samples created a waveform of the fast signal.

- Later designs sampled at random times within the time span represented by one sweep; the samples were displayed at horizontal positions corresponding to the delay from sweep start.

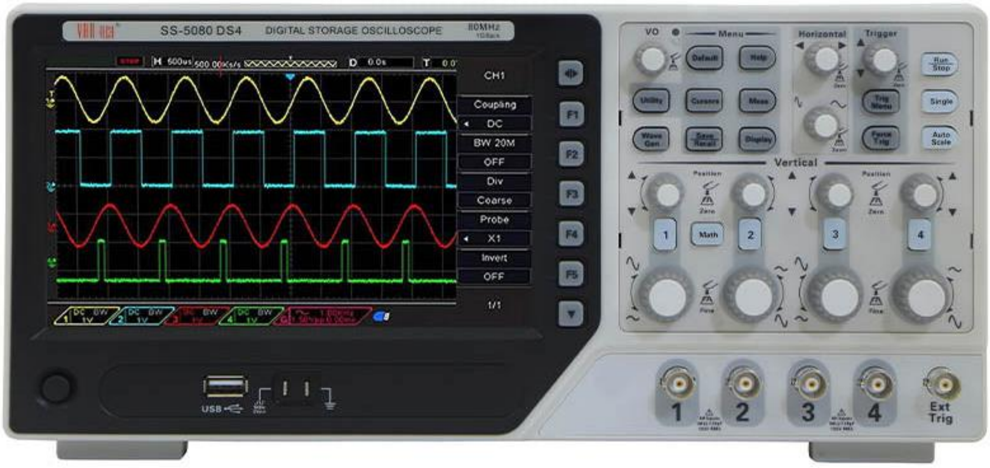
- Triggering used tunnel diodes and frequency dividers.

Block diagram Representation of Digital storage oscilloscope:

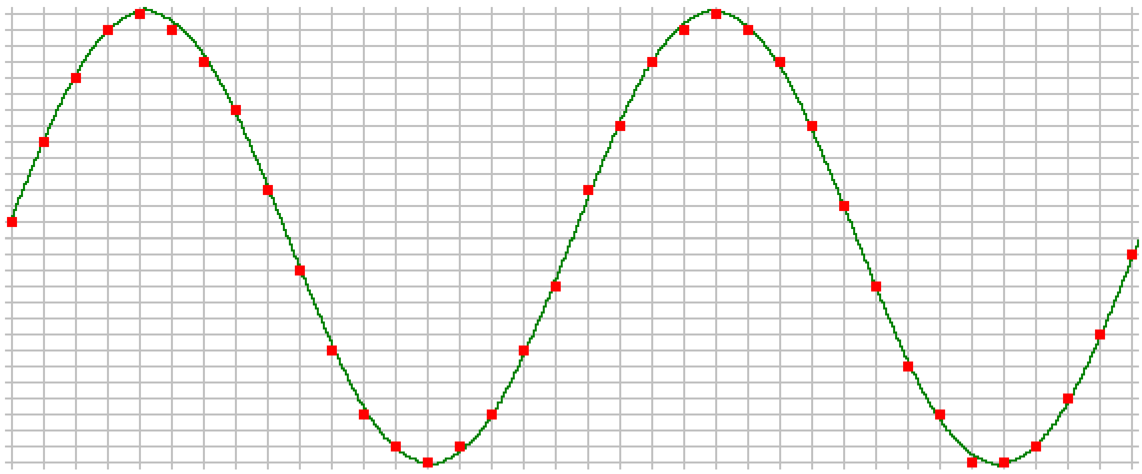




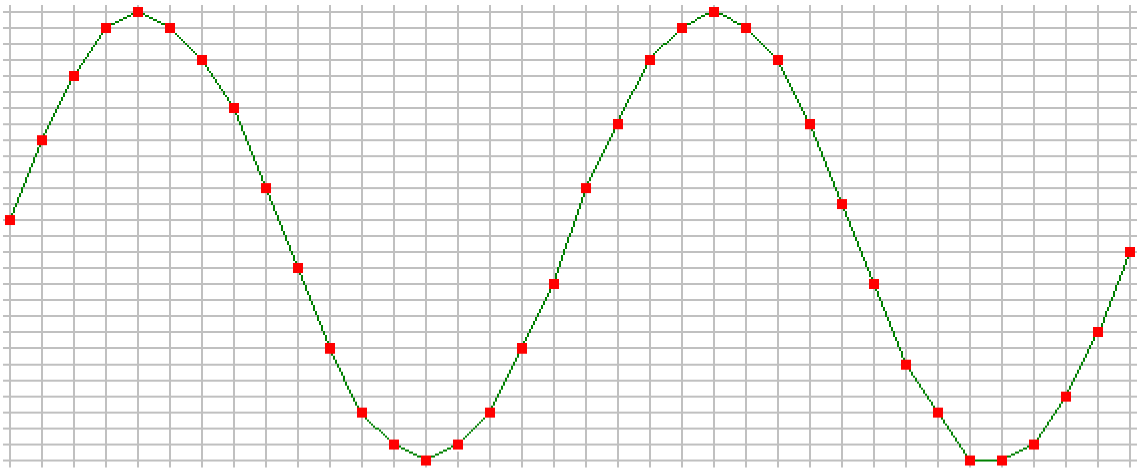
Front panel Diagram:



When sampling the input signal, samples are taken at fixed intervals. At these intervals, the size of the input signal is converted to a number. The accuracy of this number depends on the resolution of the instrument. The higher the resolution, the smaller the voltage steps in which the input range of the instrument is divided. The acquired numbers can be used for various purposes, e.g. to create a graph.

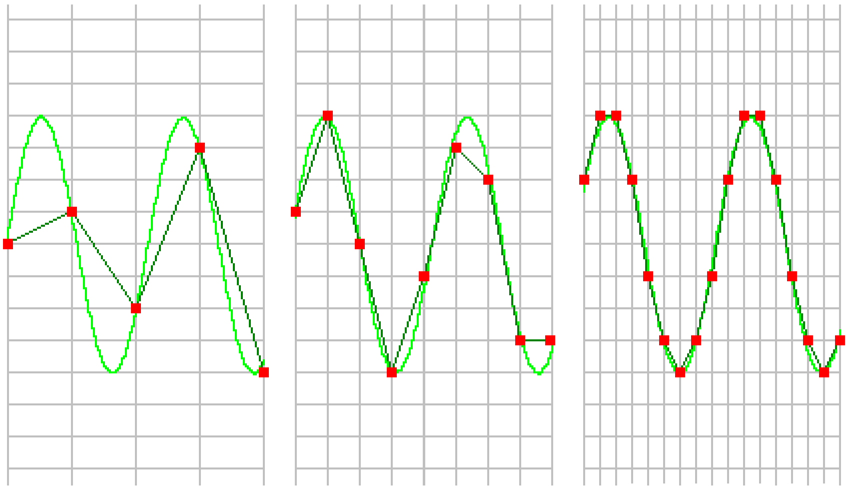


The sine wave in the above picture is sampled at the dot positions. By connecting the adjacent samples, the original signal can be reconstructed from the samples. You can see the result in the next illustration.



Sample frequency

The rate at which the samples are taken is called the **sampling frequency**, the number of samples per second. A higher sampling frequency corresponds to a shorter interval between the samples. As is visible in the picture below, with a higher sampling frequency, the original signal can be reconstructed much better from the measured samples.



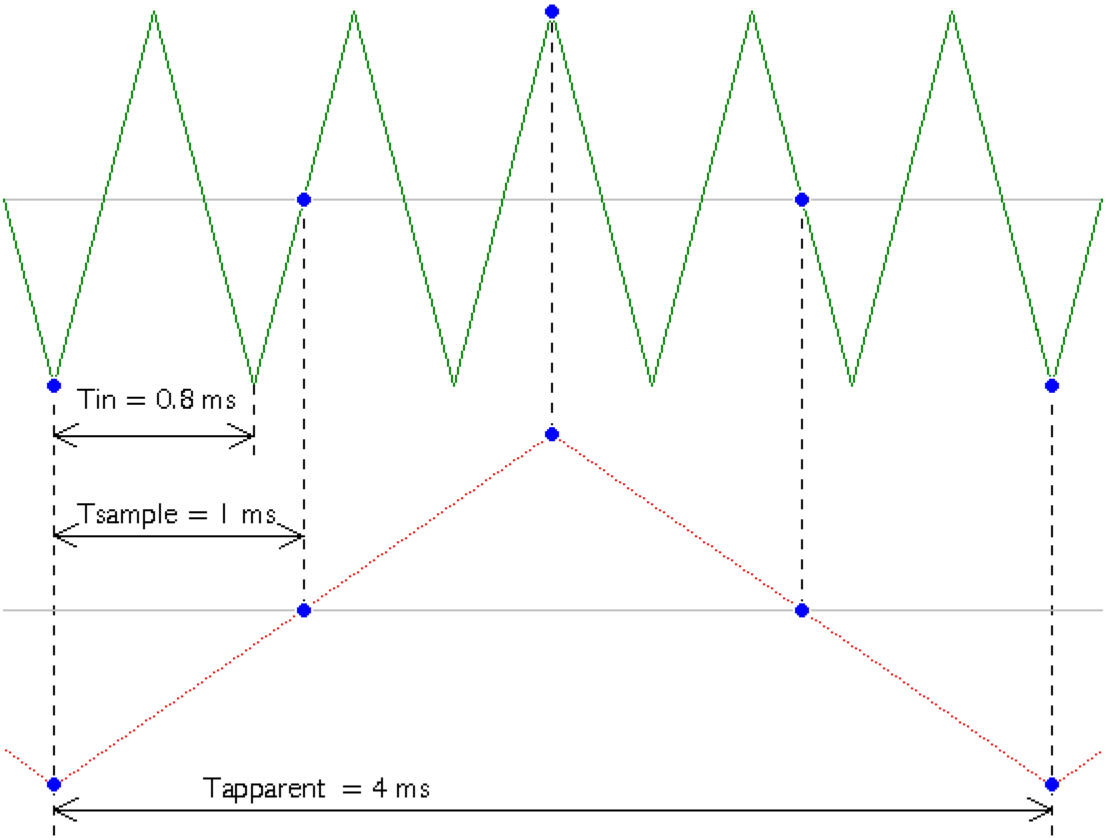
The sampling frequency must be higher than 2 times the highest frequency in the input signal. This is called the **Nyquist frequency**. Theoretically it is possible to reconstruct the input signal with more than 2 samples per period. In practice, 10 to 20 samples per period are recommended to be able to examine the signal thoroughly.

Aliasing

When sampling an analog signal with a certain sampling frequency, signals appear in the output with frequencies equal to the sum and difference of the signal frequency and multiples of the sampling frequency. For example, when the sampling frequency is 1000 Hz and the signal frequency is 1250 Hz, the following signal frequencies will be present in the output data:

Multiple of sampling frequency	**1250 Hz signal**		**-1250 Hz signal**	
...				
-1000	-1000 + 1250 =	**250**	-1000 - 1250 =	-2250
0	0 + 1250 =	1250	0 - 1250 =	-1250
1000	1000 + 1250 =	2250	1000 - 1250 =	-250
2000	2000 + 1250 =	3250	2000 - 1250 =	750
...				

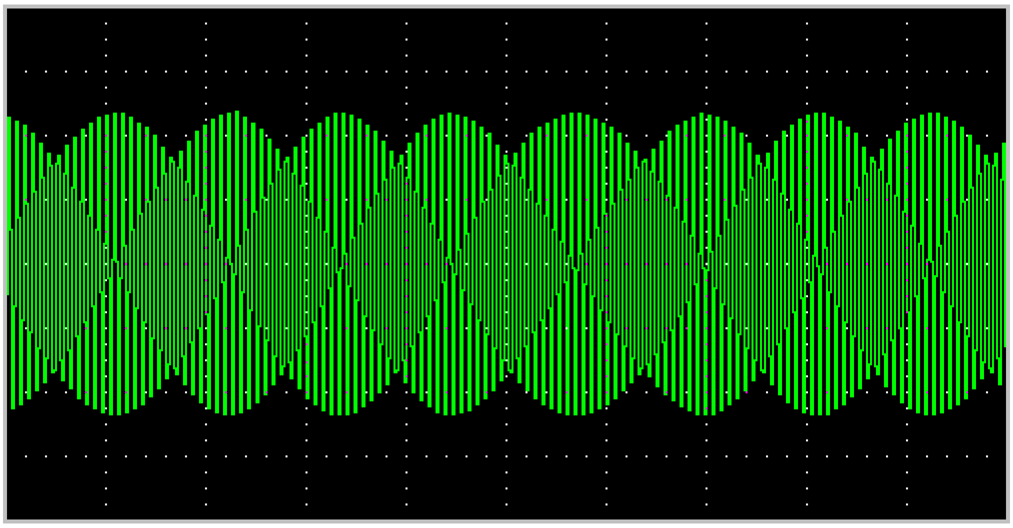
As stated before, when sampling a signal, only frequencies lower than half the sampling frequency can be reconstructed. In this case the sampling frequency is 1000 Hz, so we can we only observe signals with a frequency ranging from 0 to 500 Hz. This means that from the resulting frequencies in the table, we can only see the 250 Hz signal in the sampled data. This signal is called an **alias** of the original signal. If the sampling frequency is lower than 2 times the frequency of the input signal, **aliasing** will occur. The following illustration shows what happens.



In this picture, the green input signal (top) is a triangular signal with a frequency of 1.25 kHz. The signal is sampled with a frequency of 1 kHz. The corresponding sampling interval is 1/(1000 Hz) = 1 ms. The positions at which the signal is sampled are depicted with the blue dots.

The red dotted signal (bottom) is the result of the reconstruction. The period time of this triangular signal appears to be 4 ms, which corresponds to an apparent frequency (alias) of 250 Hz (1.25 kHz - 1 kHz).

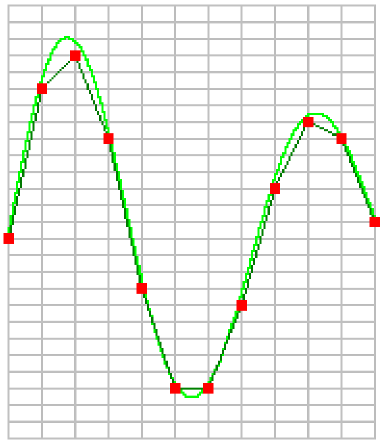
In practice, to avoid aliasing, always start measuring at the highest sampling frequency and lower the sampling frequency if required.



In this picture, a sine wave signal with a frequency of 257 kHz is sampled at a frequency of 50 kHz. The minimum sampling frequency for correct reconstruction is 514 kHz. For proper analysis, the sampling frequency should have been approximately 5 MHz.

Record Length

With a given sampling frequency, the number of samples that is taken determines the duration of the measurement. This number of samples is called **record length**. Increasing the record length, will increase the total measuring time. The result is that more of the measured signal is visible. In the images below, three measurements are displayed, one with a record length of 12 samples, one with 24 samples and one with 36 samples.



The total duration of a measurement can easily be calculated, using the sampling frequency and the record length:

Measurement duration in seconds = record length in samples / sampling frequency in Hz

Time base

The combination of sampling frequency and record length forms the **time base** of an oscilloscope. To setup the time base properly, the total measurement duration and the required time resolution have to be taken in account.

There are several ways to find the required time base setting. With the required measurement duration and sampling frequency, the required number of samples can be determined:

record length in samples = Measurement duration in seconds * sampling frequency in Hz

With a known record length in samples and the required measurement duration, the necessary sampling frequency can be calculated:

sampling frequency in Hz = record length in samples / Measurement duration in seconds

Resolution

When digitizing the samples, the voltage at each sample time is converted to a number. This is done by comparing the voltage with a number of levels. The resulting number is the number of the highest level that's still lower than the voltage. The number of levels is determined by the resolution. The higher the **resolution**, the more levels are available and the more accurate the input signal can be reconstructed. In the image below, the same signal is digitized, using three different amounts of levels: 16, 32 and 64

The number of available levels, is determined by the **resolution**:

number of levels = $2^{\text{resolution in bits}}$

The used resolutions in the previous image are respectively: 4 bits, 5 bits and 6 bits.

The smallest detectable voltage difference depends on the resolution and the input range. This voltage can be calculated as:

minimum voltage = full scale range / number of levels

Conclusion:

Familiarized with various components and equipment to be used to build and test electronic circuits.

Exp.No : 2 (B)	LED Emergency Light Circuit
Date :	

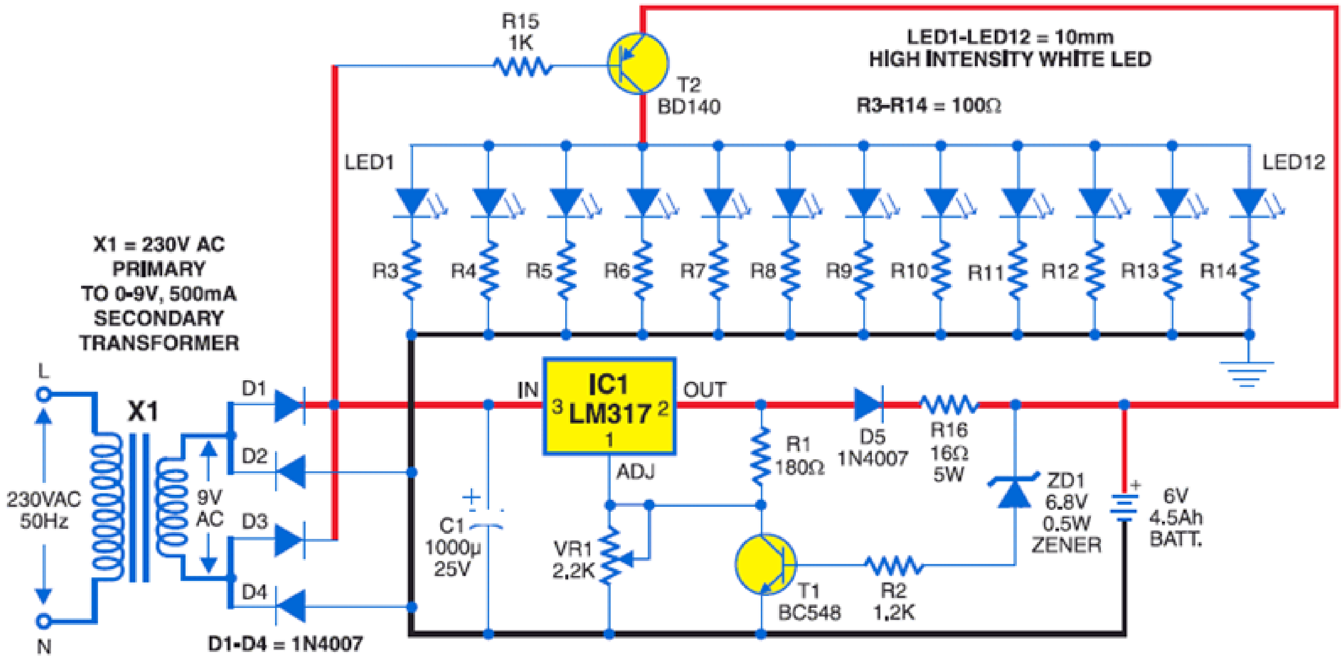
Aim

To design an automatic emergency lamp.

Components

S.No	Name of the Components	Range / Type	Quantity
1	Step down Transformer	(9-0-9)V	1
2	Potentiometer	2.2 KΩ	1
3	Resistors	1KΩ,1.2Ω, 16Ω and 180Ω (0.25 Watts)	Each one
4	Resistors	100Ω(0.25 Watts)	12
	Capacitor	1000μF/Electrolytic	
5	LED	White,10mm	12
6	Transistor	BD140, BC548	Each one
7	Diode	1N4007	4
	Zener Diode	6.8 V,0.5 Watts	1
8	Battery	6V,4.5Ah	1
9	LM 317-IC	-	1
10	Connecting wires	Single Lead Wire	Reqd. amt.
11	Wire stripper, breadboard	-	Each One

Circuit Diagram



Procedure

1. Connect the circuit as per the circuit diagram in bread board.
2. check the circuit connectivity before turning on the AC input source.
3. Switch ON the main power supply and check the charging voltage across the battery terminals.
4. Once the battery attains its full capacity off rated voltage switch OFF the main AC power supply
5. Ensure that the LEDs are driven through the battery
6. Observe the output

Result

Thus an automatic emergency lamp has designed and output has been observed.

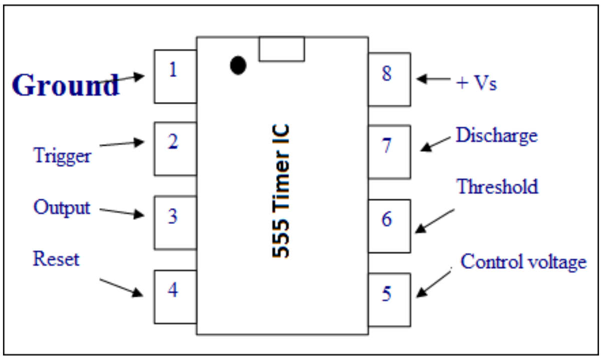
Exp.No : 3	IR TransReceiver Circuit
Date :	

Aim

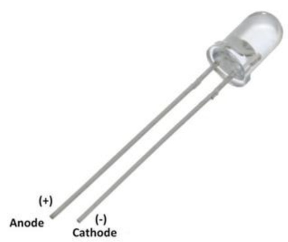
To make an IR Transmitter and Receiver circuit on bread board.

Components:

S.No	Name of the Components	Range / Type	Quantity
1	555 Timer IC	-	1
2	Potentiometer	10KΩ	1
3	Resistors	1KΩ, 10KΩ,220KΩ,470KΩ	As per ckt.
4	Capacitors	0.01µF, 1 µF	Each one
5	Transistor	BC558	1
6	IR Transmitter LED	-	1
7	IR Receiver	-	1
8	Visible LED	Red	1
9	DC Power Supply	5v	1
10	Connecting wires	Single Lead Wire	Reqd. amt.
11	Wire stripper, breadboard	-	Each One



Pin out of 555 Timer IC:



Pin out of IR transmitter:

InfraRed

Infrared (IR) communication is a very common wireless communication technology. IR communication is an easy to use and inexpensive wireless communication. IR Communication generally comprises of IR Transmitter and Receiver.

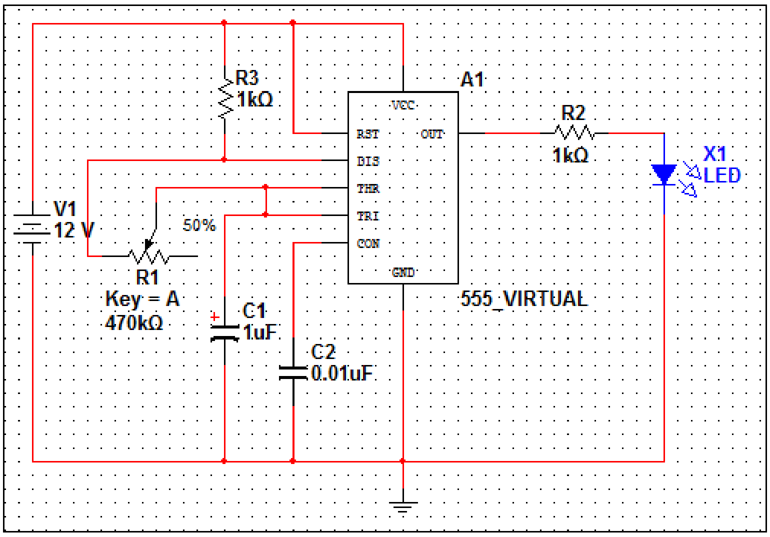
The most common use of Infrared (IR) communication is remote controls of different appliances like TV's. The handheld remote control of the TV consists of IR Transmitter and the IR Receiver is placed at the TV.

Some embedded projects also consists of IR Transmitter and Receiver Modules where they can be used as proximity sensors or distance measurement sensors.

IR LED (Infrared Transmitter) is a special type of LED that emits Infrared rays of the Electromagnetic Spectrum. The wavelength of Infrared Rays is greater than that of Visible light and hence they are invisible to human eye.

A typical IR LED emits infrared rays in a wavelength range of 740 – 760 nm.

Circuit Diagram- IR Transmitter



Procedure

1. Place the components on the board according to the given circuit diagram.
2. Connect them by using soldering iron and materials
3. Switch ON the power supply and vary the potentiometer
4. Observe and verify the output.

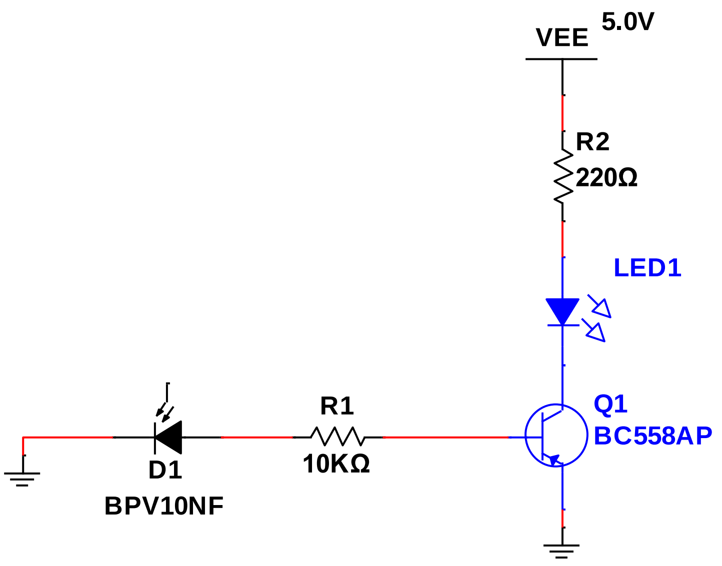
IR Receiver or Photodiode

Infrared receivers or infrared sensors detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation.

Applications

Remote controls, safety alarm systems, and short range wireless communication

Circuit diagram- IR Receiver



Procedure

1. Connect the supply connections and place nearby the IR LED Transmitter circuit
2. Apply the power supply to the receiver circuit
3. When the IR signal is received LED will start blink
4. Observe the output.

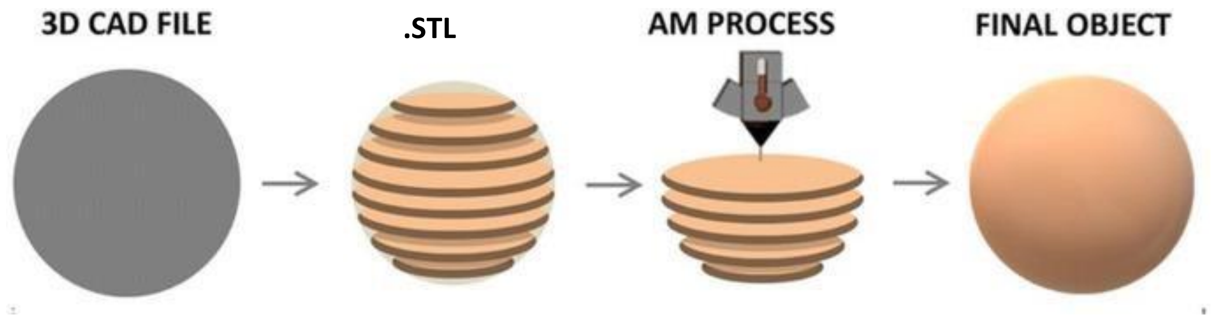
Result

The simple IR Transmitter and Receiver circuit is constructed and its output is also verified.

Introduction to 3D printing

Three-dimensional (**3D**) **printing** or **Additive Manufacturing (AM)** is a process that creates a physical object from a digital design. The process works by laying down thin layers of material in the form of liquid or powdered plastic, metal or cement, and then fusing the layers together to build the final product. The important steps in 3D printing are discussed in the next session.

3D printing process



Design the Computer Aided Design model

Conversion to standard file format and printing

Final Design

The International Standard Organization/American Society for Testing and Materials standards (ISO/ASTM 52900:2015) classify the AM processes into seven categories, known as material extrusion, vat photopolymerization, material jetting, binder jetting, powder bed fusion process, sheet lamination and direct energy deposition. In these different materials can be processes.

In this exercise, two 3D printing processes will be studied in detail, Fused Deposition Modelling (FDM) and Digital Light Processing (DLP) processes. The details related to these processes are explained below.

Fused Deposition Modelling

There are different methods of 3D printing, but the most widely used is Fused Deposition Modelling (FDM). FDM printers use a thermoplastic filament, which is heated nearer to its melting point and then extruded, layer by layer, to create a three-dimensional object. Objects created with an FDM printer start out as computer-aided design (CAD) files. Before an object can be printed, its CAD file must be converted to a format that a 3D printer can understand, usually .STL format.

FDM printers use two kinds of materials, a modelling material, which constitutes the finished object, and a support material, which acts a scaffolding to support the object as it's being printed. After printing these scaffolds are removed and some post processing is done to improve the surface finish and quality.

During printing, these materials take the form of plastic threads, or filaments, which are unwound from a coil and fed through an extrusion nozzle. The nozzle melts the filaments and extrudes them onto a base, sometimes called a build platform or table. Both the nozzle and the base are controlled by a computer that translates the dimensions of an object into X, Y and Z coordinates for the nozzle and base to follow during printing.

In a typical FDM system, the extrusion nozzle moves over the build platform horizontally and vertically, "drawing" a cross section of an object onto the platform as shown in figure 1. This thin layer of plastic cools and hardens, immediately binding to the layer beneath it. Once a layer is completed, the base is lowered or the deposition head is raised by the required amount of predefined layer thickness.

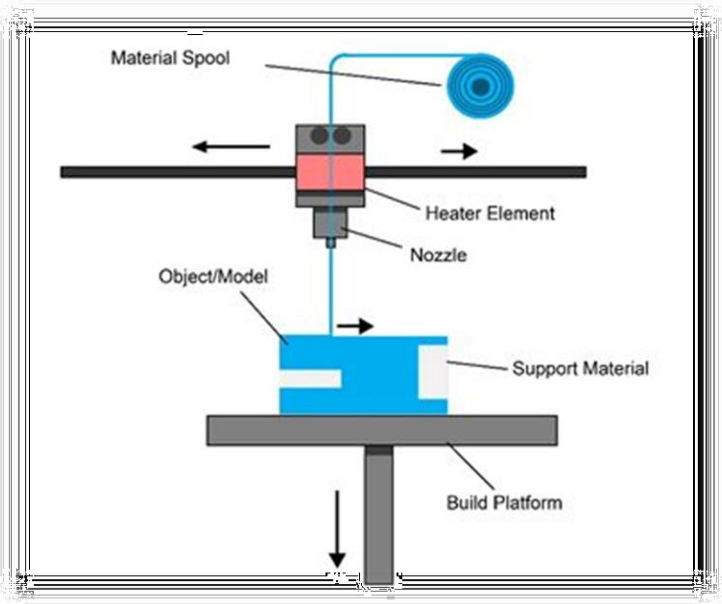


Fig. 1. Fused Deposition Modelling Schematic

Process steps in FDM process

These process steps are common for all the AM process, for Fused Deposition Modelling the process sequence is shown in the figure 2. For FDM the print file, a machine- readable file is prepared with the help of any slicing software. One such open-source slicing software is Ultimaker Cura (refer figure 3), which is widely used for many FDM machines available in the market. In Cura, the complete process plan for FDM can be done and the sliced data is stored as a machine-readable g-code file which is fed into the machine for printing the parts. The important step in the process planning is the path planning and process parameter selection because this will decide the part quality and time for fabricating the part.

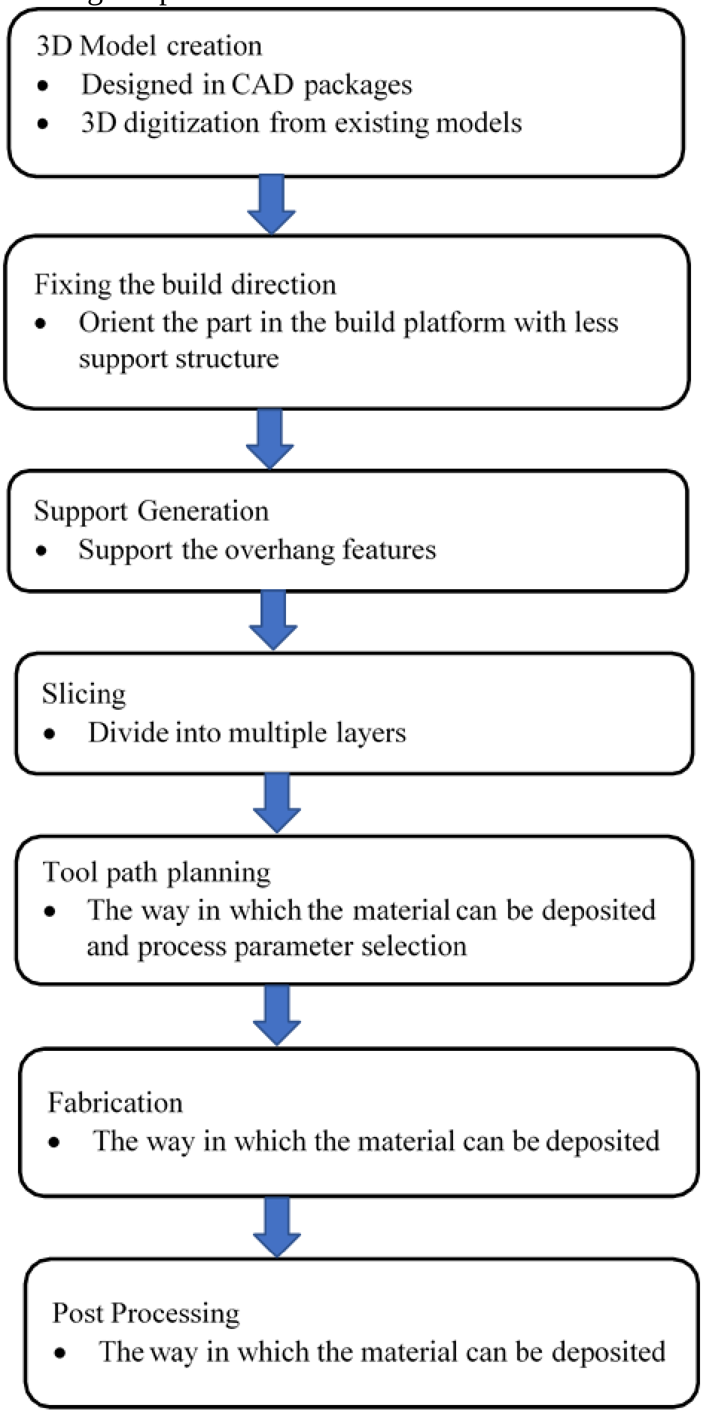


Fig. 2 Process steps for fused deposition modelling process

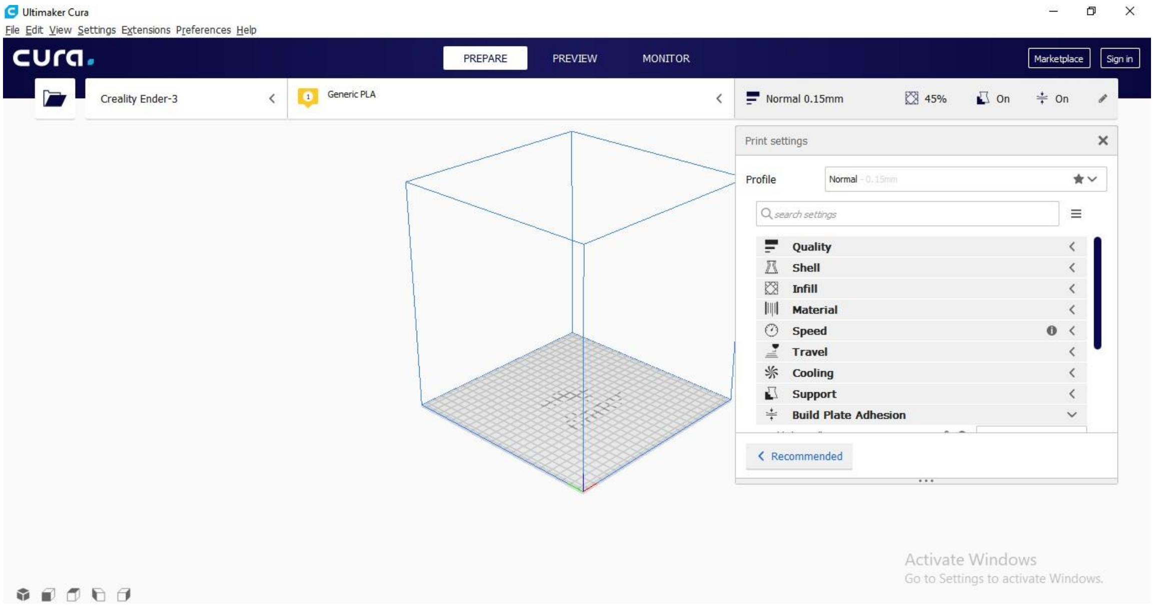


Fig. 3 User interface for Ultimaker cura

- Print volume: 220 x 220 x 250mm.
- Nozzle: Single 0.4mm.
- Filament: 1.75mm.
- Heated bed temperature: 110°C
- Max. print speed: 180 mm/s.
- Layer resolution: 0.1 – 0.4mm (100-400 microns)

Fig. 4 Creality ender 3 printer and it’s specifications

Fig. 5 Mojo 3D printer

Table 1 Advantages and disadvantages of FDM process

Advantages	**Disadvantage**
Geometry free fabrication	Low speed production
Low technology and materials costs	Limited accuracy and limitation
Easy to operate and material handling	Limited surface finish
Low temperature operation	Staircase effect, distortion, shrinkage and warping
Low production and maintenance cost	Support structures are required for complex geometries and features
Low process toxicity	Removal of support structures
Low power consumption	Limited range of materials
Multiple materials systems are available	Limited mechanical strength of parts
Colour parts can be generated	Limited building volume or workspace
Compact design and office friendly	
Low noise operation and dust emissions	
Low odour generation	
Mass customization	
Product personalization	

Digital Light Processing (DLP)

Digital Light Processing is another 3D printing technology comes under the vat photopolymerization process, where we use a liquid photopolymer resin to make 3D models layer by layer. In FDM only thermoplastics material can be processed but in DLP, we can process thermoset plastic component also. The basic principle behind the printing process is photopolymerization, is a technique that uses light (visible or ultraviolet; UV) to initiate and propagate a polymerization reaction to form a linear or crosslinked polymer structure. The material used in this process is called photopolymer.

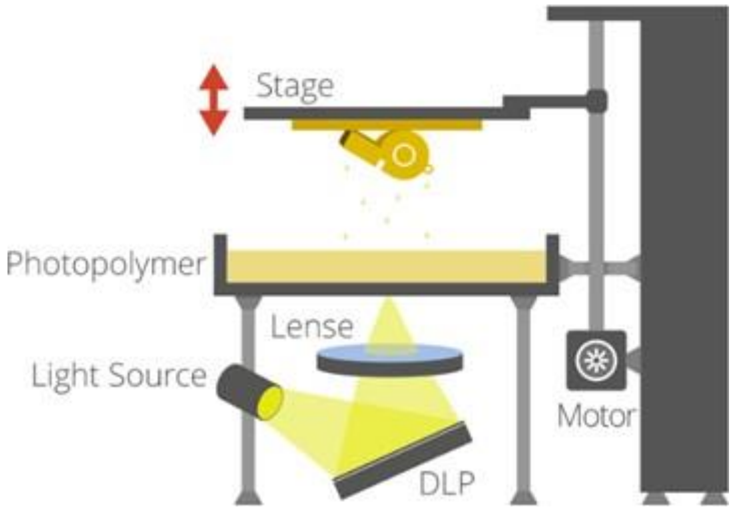


Fig. 6 Schematic of DLP 3D printer

In this process, once the 3D model is prepares using the slicing software then send the data to the 3D printer. Then a vat of liquid polymer is exposed to light from a DLP projector under safelight conditions. The DLP projector displays the image of the 3D model onto the liquid polymer. The exposed liquid polymer hardens and the build plate moves down and the liquid polymer is once more exposed to light. The process is repeated until the 3D model is complete and the vat is drained of liquid, revealing the solidified model. DLP 3D printing is faster and can print objects with a higher resolution.

The process steps are similar to the FDM process, but only difference is about the slicing software and parameters used for converting the CAD file into sliced data. The DLP printer for this exercise in Anycubic photos S and the software used for the part preparation is photon workshop (suitable for all Anycubic photon DLP printers). The technical specification of the printer is listed in table 2. The details of the machine and its components are shown in figure 7 and 8.

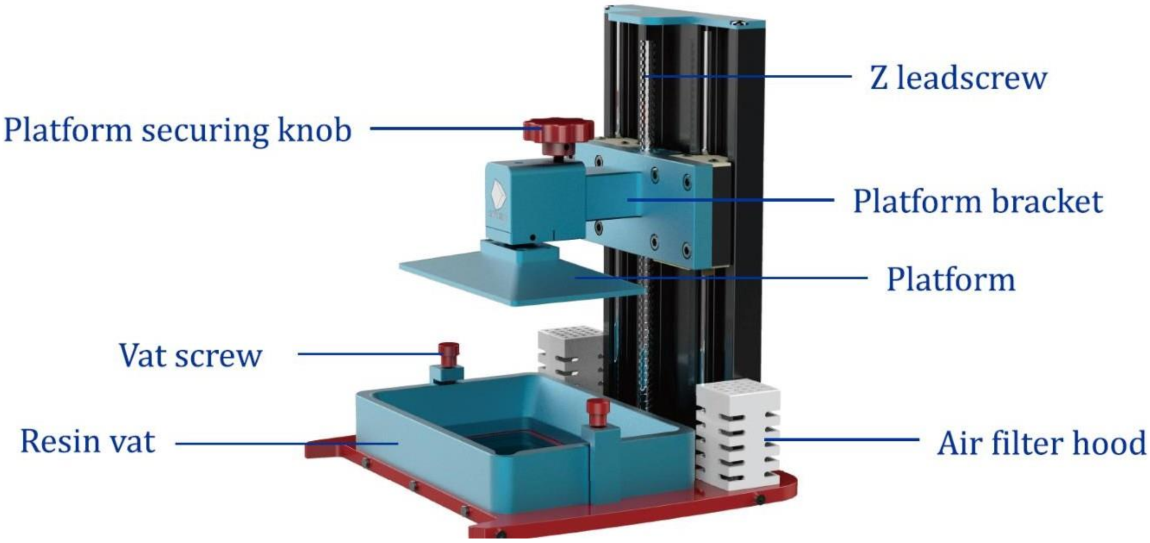


Fig. 7 Machine configuration

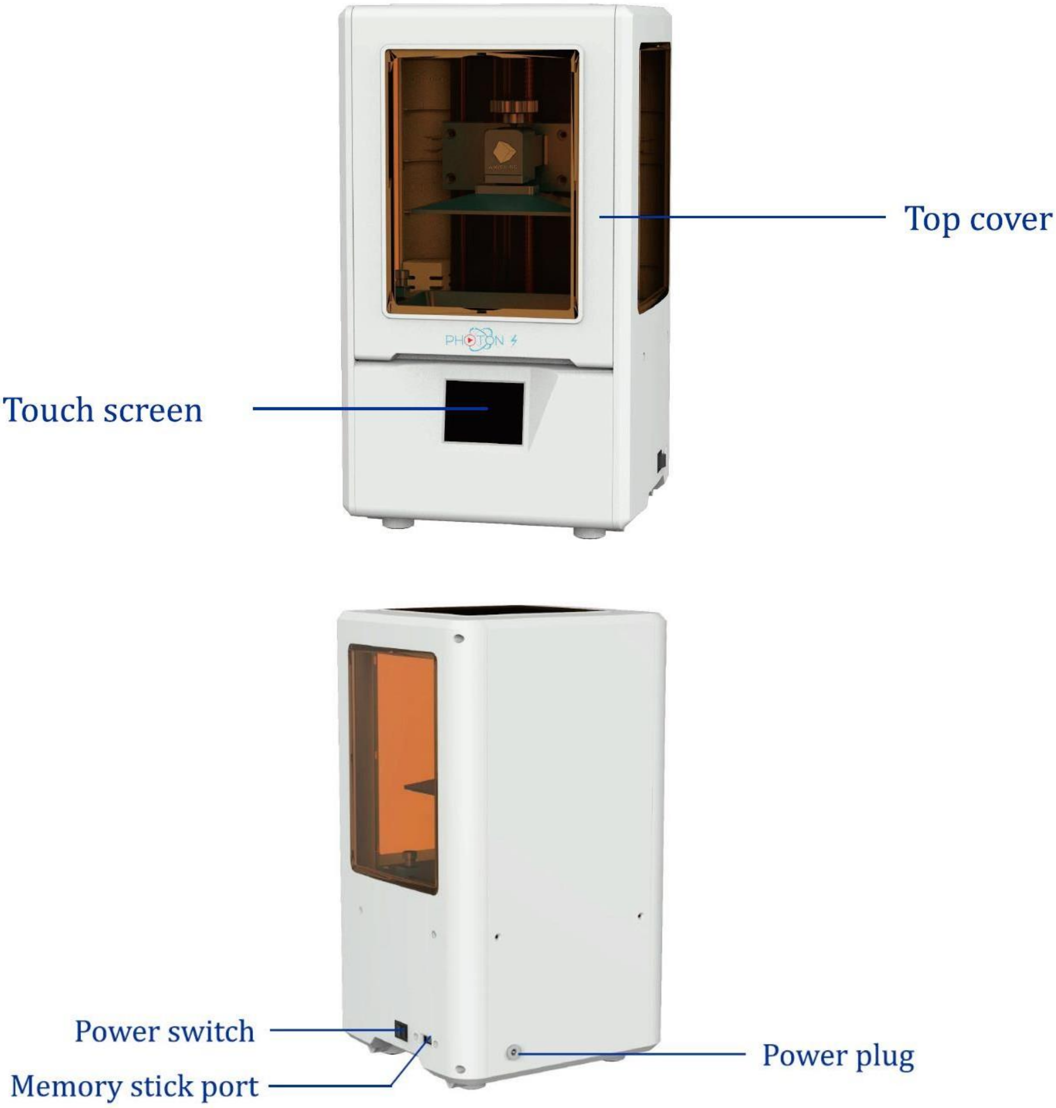


Fig. 8 Anycubic Photon S

Table 2. Technical specification of the printer

Technique	LCD shadow masking
Light source	UV-LED (wavelength 405nm)
XY resolution	0.047 mm
Z axis accuracy	0.00125 mm
Layer thickness	0.01 ~ 0.2 mm
Print speed	20mm/h
Rated power	50W
Build volume	115 mm (L) * 65 mm (W) * 165 mm (H)
Materials	405nm UV resin

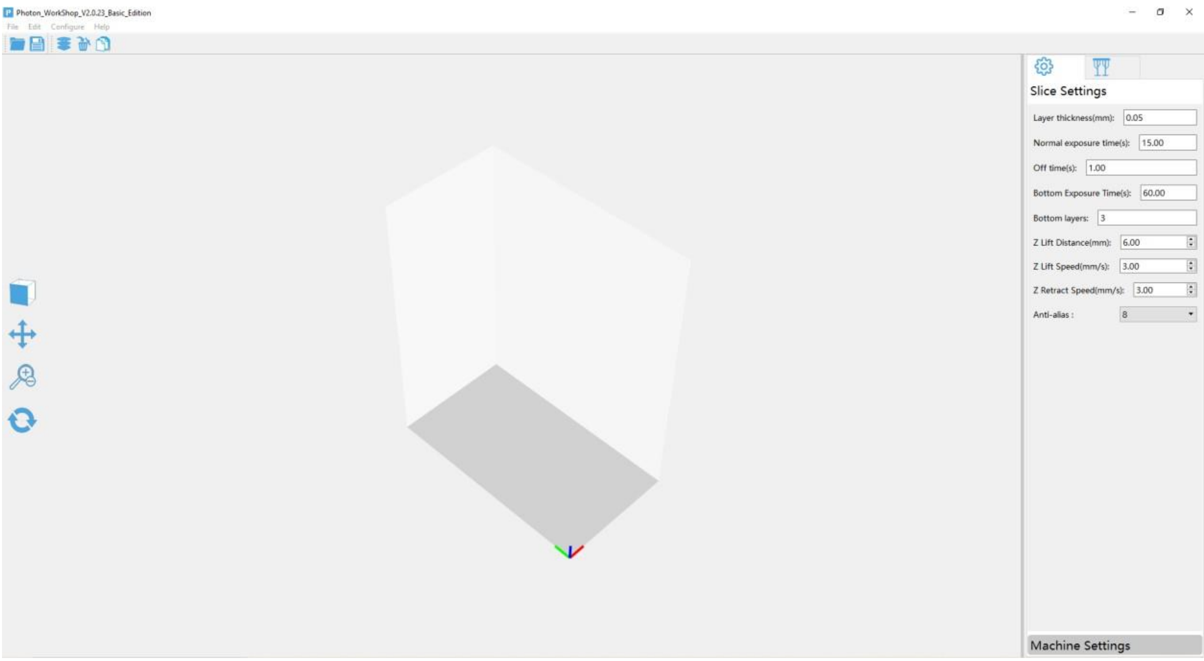


Fig. 9 Photon workshop software interface

The CAD models can be either designed or taken from any open-source repositories like thingiverse (https://www.thingiverse.com/), Yeggi (https://www.yeggi.com/), Free3D (https://free3d.com/).

Exp.No : 4 (A)	3D printing using using Ender 3 (FDM)
Date :	

Aim

To understand the process parameter setting for 3D printing using Ultimaker Cura and printthe part using Creality ender3.

Apparatus required

Ultimaker Cura, Creality ender 3, filament

Procedure

- Create/ download the CAD model for 3D printing and export as .STL file
- Load the .STL file in the Cura software
- Fix the process parameters in the Cura and slice the model
- Save the sliced file in the memory card and load the part into the machine
- Remove the part from the build platform after printing and perform the post processing

Result

Exp.No : 4 (B)	3D printing using Anycubic Photon (SLA)
Date :	

Objective

To understand the process parameter setting for 3D printing using photon workshop and part printing using Anycubic photon 3D printer.

Apparatus required:

Photon workshop, Anycubic Photon S, UV curable resin

Procedure:

- Csssssreate/ download the CAD model for 3D printing and export as .STL file
- Load the .STL file in the photon workshop software
- Fix the process parameters in the photon workshop and slice the model
- Save the sliced file in the memory card and load the file into the machine
- Remove the part from the build platform after printing and perform the postprocessing

Result

Exp.No : 5 (A)	Staircase Wiring
Date :	

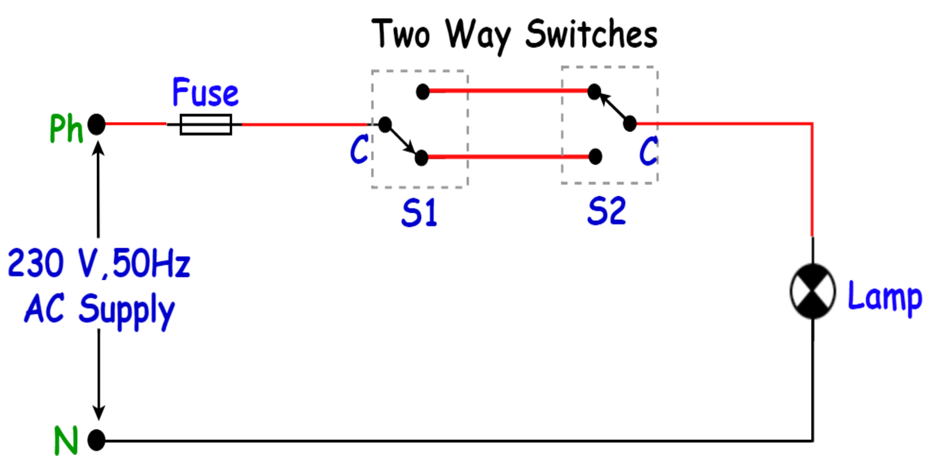
Aim

To make a staircase wiring using 2-way switches.

Apparatus required

S.No	Name of the apppratus	Range / Type	Quantity
1	Two way switch (SPDT)	230V,6 A,NC	2
2	Lamp Holder		1
3	Incandescent lamp	230 V,60W	1
4	Fuse	5 A	1
5	PVC conduit	Casing and caping / Pipe	Reqd. amt.
6	Connecting wires	1.5sq.mm Copper wire	Reqd. amt.
7	Wire stripper,Line Tester,Screw Driver set and Cutting Plier	-	Each One

Circuit diagram



Working principle

Staircase wiring refers to the arrangement and installation of electrical wiring and switches in a staircase area. It enables the control of lights at different floors or levels of a building from multiple switch locations, ensuring ease of use and energy efficiency. With staircase wiring, users can conveniently switch on or off the lights at various points along the staircase, avoiding the need to traverse the entire staircases to control the lighting.

Procedure

1. Make the connections as per circuit diagram.
2. Observe the lamp status when switches are actuated.

Result

The working principle of staircase wiring is learnt and th same is built and checked.

Exp.No : 5 (B)	Godown Wiring
Date :	

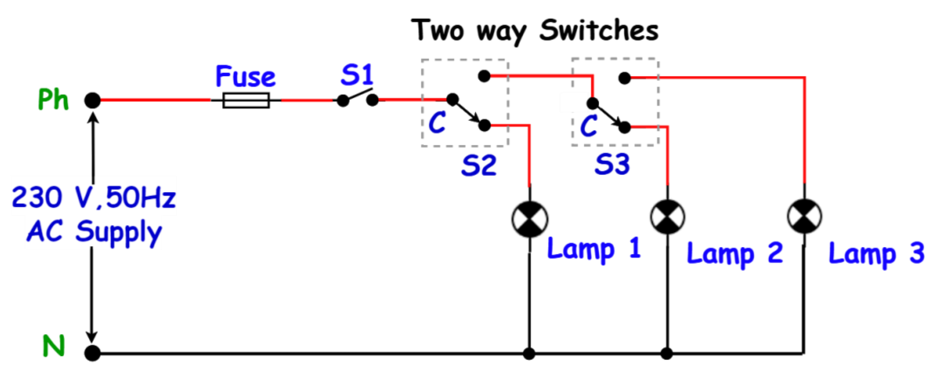
Aim

To make a Godown wiring using SPST and SPDT switches.

Apparatus required

S.No	Name of the apppratus	Range / Type	Quantity
1	One way switch (SPST)	230V,6 A,NO	1
2	Two way switch (SPDT)	230V,6 A,NC	2
3	Lamp Holder		3
4	Incandescent lamp	230 V,60W	3
5	Fuse	5 A	1
6	PVC conduit	Casing and caping / Pipe	Reqd. amt.
7	Connecting wires	1.5sq.mm Copper wire	Reqd. amt.
8	Wire stripper,Line Tester,Screw Driver set and Cutting Plier	-	Each One

Circuit diagram



Working principle

Godown wiring uses to operate lamps/loads in a sequential manner, where only one load operates at a time.As its name implies"Godown wiring ", it is commonly used for light switching in godowns,tunnel-like structures, long passages.. etc, where the light is only required for passage or it requires only at one position at a time. The advantage of the godown wiring is the previous load will be turned off when we normally switch ON the next load.

Procedure

1.Make the connections as per circuit diagram

2.Observe the lamp status when switches are actuated.

Switch ON	**Corresponding Lamp**	**ON/OFF**
Switch 1 (S1)	Lamp 1	
Switch 2 (S2)	Lamp 2	
Switch 3 (S3)	Lamp 3	

Result

Thus the Godown wiring using SPST and SPDT switches was learnt and the same is built and checked.

Exp.No : 6A	Carpentary Shop-Introduction
Date :	

Introduction

Carpentry may be designed as the process of making wooden articles and components such as roots, floors, partitions, doors and windows. 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 T- joints, bridle joints, etc.

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

It is used to marking lines parallel to the edges of a wooden piece. 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. It consists of two pins; the distance between the pins is adjustable. It is used to draw parallel lines on the stock.

Measuring Tools

The carpentry measuring tools are classified as follows

1. Steel tape, 2. Steel rule, and 3. Caliper

Steel tapes and steel rules are mainly used for measuring short and lengths in millimeters. A try square is used for testing squareness and marking of joints. A meter square is used for marking and measuring an angle of 45 degree. A bevel square is used for marking and listing angles between 0 degree to 180 degree.

Calipers are used for the precision measurement of cylindrical surface. Inside calipers are used for measuring outside diameter and outside calipers are used to measure inner diameter of a pipe.

Work Holding Tools

The carpentry holding tools are shown in below fig.

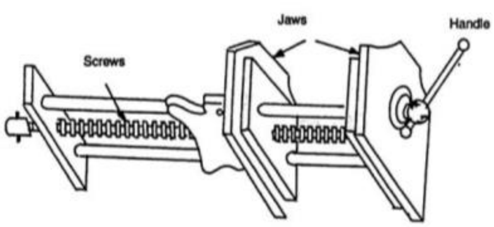


Fig. Carpenters Bench Vice

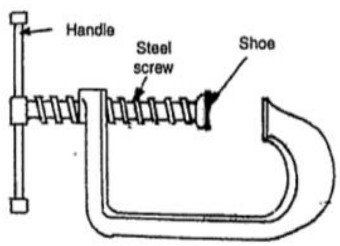


Fig. C- Clamp

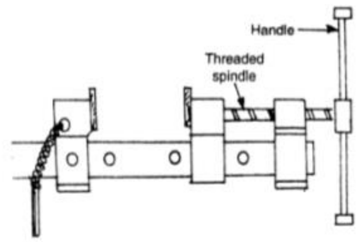


Fig. Bar or T-Cramp

Carpentry vice

It is a work holding device. When handle vice is turned in a clockwise direction, the sliding jar forces the work against the fixed sawn. The greater the force applied to the handle, the tighter to the work held.

Bar lamp

It is a rectangular (or) square block with V-groove on one or both sides opposite to each other. It holds cylindrical work pieces.

C-Clamp

This is used to hold work against an angle plate or V-block.

Cutting Tools

Saws

a) Hack saw

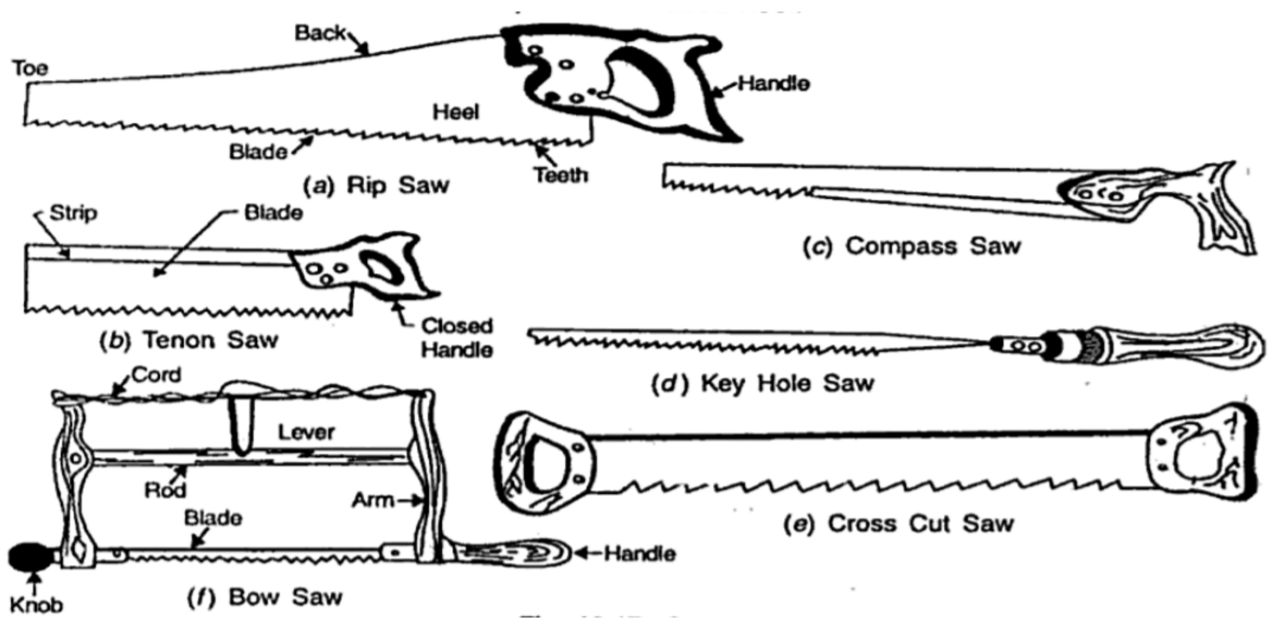
It is used to cross cut the grains of the stock. The teeth are so set that the saw kerfs will be wider than the blade thickness. Hard blades are used to cut hard metals. Flexible blades are having the teeth of hardened and rest of the blade is soft and flexible.

b) Rip Saw

It is used for cutting the stock along the grains. The cutting edge of this saw makes a sleeper angle about 60° whereas that saw makes an angle of 45° with the surface of the stock.

c) Tenon saw

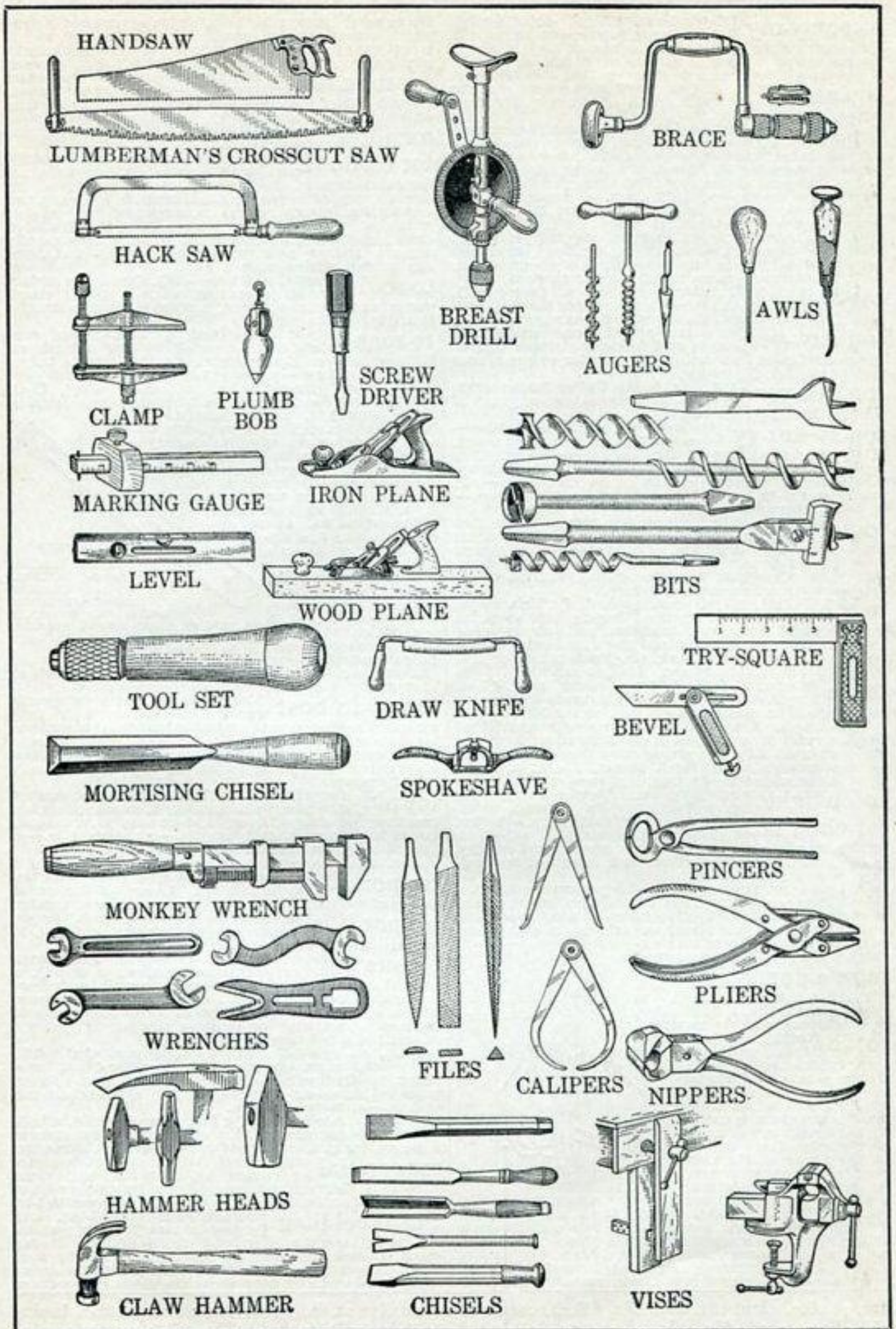
It is used for cutting tenons and in fine cabinet works. The blade of this saw is very thin and so it is used stiffed with back strip. Hence, this is sometimes called back saw. The teeth shapes similar to cross cut saw.



Chisels

These are used for removing surplus wood. Chisels are annealed, hardened and tempered to produce a tough shank and a hard cutting edge.

All common tools used by carpenters are shown in the following figure



Common Tools Used by Carpenters

Exp.No : 6 (B)	Dovetail Joint- Carpentary
Date :	

Aim

To make the Dovetail-joint the required dimensions from the given work piece.

Material Required

Soft wood of size 300 x 50 x 50 mm.

Tools Required

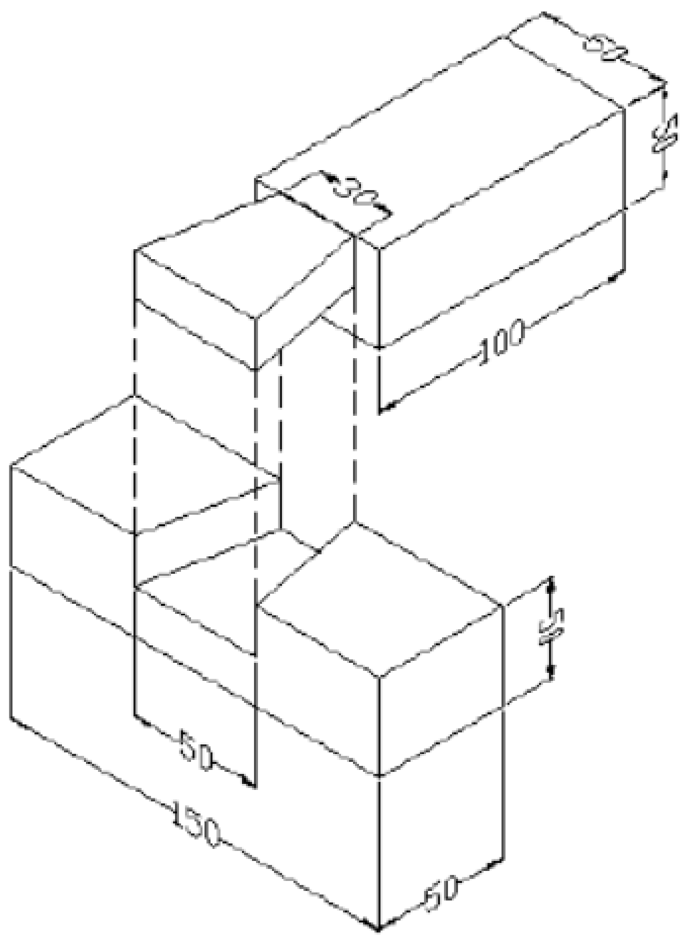
1. Jackplane
2. Carpentry vice
3. Try square
4. Marking gauge
5. Steel rule
6. Tenon saw
7. Rip saw
8. Firmer chisel
9. Mallet

Procedure

1. The given work piece 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 planned faces are checked.
3. Now the other two surfaces are planned to get smooth surface.
4. The work piece is cut into two pieces by using the rip saw.
5. Using the steel rule and marking gauge, marking is done for Dovetail-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 work piece.
7. Using the jack plane, the other two faces of work piece is planned to the required size.
8. The finished two pieces are assembled to getter to form the Dovetail-joint.
9. Finally, the finished job is checked for required size and shape using the steel rule and try square.

Result:

DOVETAIL JOINT



All dimensions are in mm.

Exp.No : 7 (A)	Sheet Metal Work
Date :	

The metal plank having less than 2 mm thickness is called sheet metal. Sheet metal work deals with the production of components in wide variety of shapes and sizes from sheet metal, with aid of tools or machines metals used in sheet metal work variety of metal shop. The characteristics and uses of some of the important metals used in sheet metal work are described below:

Galvanized iron

It is a sheet of soft steel, which is coated with zinc. Zinc resists corrosion and improves the appearance of metal. Galvanized iron is one of the least expensive metals and is used for making pans, buckets, ducts, gutters, tanks, boxes, etc.

Black iron

It is uncoated sheet of metal with bluish-black appearance. It corrodes rapidly and is not used extensively due to difficulties of soldering. The black iron sheets are used for the parts that are to be painted.

Tin plate

Tin plate is an iron or steel coated with pure tin. It has very bright silver appearance and is used for food containers, cans and pans.

Stainless steel

It is an alloy steel possessing corrosion resistance. General type stainless steel contains 18 percent chromium and 8 percent nickel. This steel is commonly known as 18-8 stainless steel. These are available in various sizes and thickness. It is widely used for food containers and dairy equipment.

Copper

It has reddish color and possesses good malleability, ductility and resistance to atmospheric corrosion.

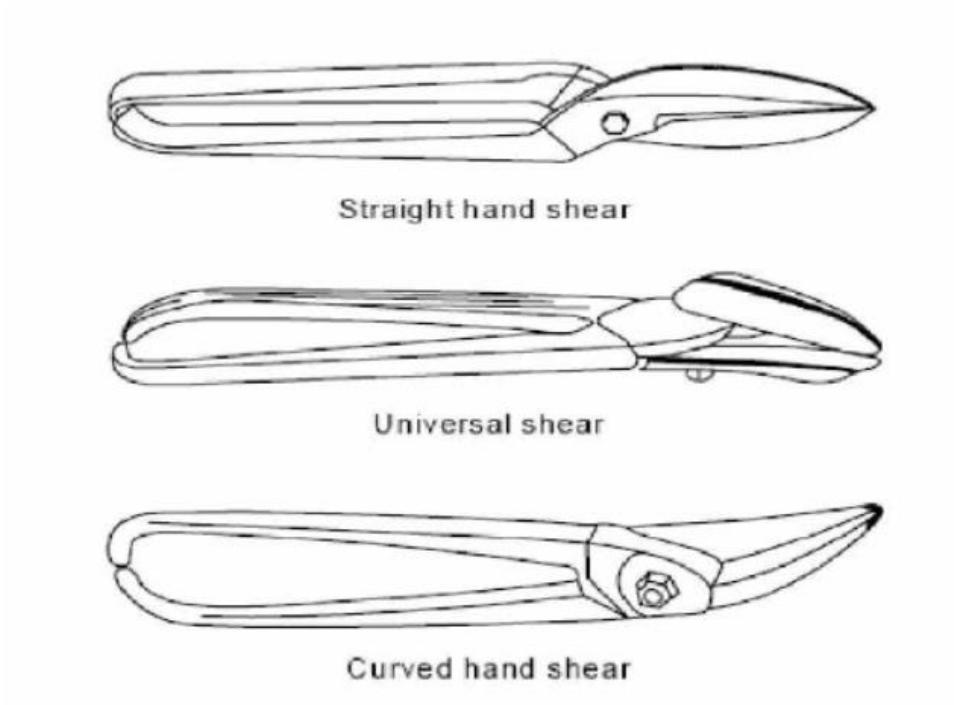
Aluminium

Sheet aluminium is never pure aluminium and it is always allowed with smallquantities of copper silicon, magnesium and iron.

TOOLS AND EQUIPMENT

Some of the tools used in fitting are also used in sheet metal work. Certain additional tools used by sheet metal worker are described below:

Snips: Hand shears or snips are used to cut sheet metal. Although there are many types, thesheet metal workers generally use straight snips and curved snips.



Bench shears: Bench shear is used for cutting thicker sheets. It is the lower fixed blade firmly secured by bracket at the bottom. The movable blade is pivoted at the rear end; the hand operating lever is attached to the front end of movable blade in a link mechanism.

STAKES

Stakes are made of steel and forged in a variety of shapes and sizes. Its working face is machined and polished to facilitate various operations such as bending, seaming or forming.

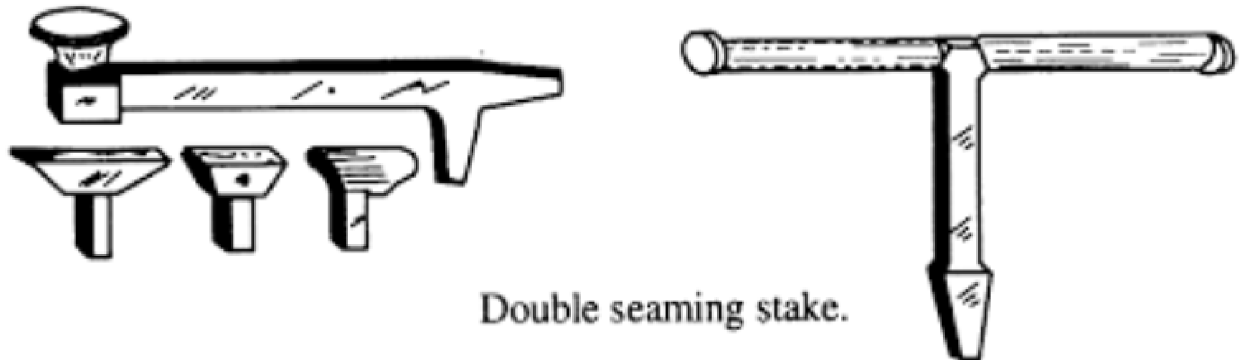
The following types of stakes are most generally used:

Double seaming stake: These stakes has two horns and it is used to make double seam for vessels. Blow horn: These stakes has two horn tapering horns and it is used to form or seam funnels. Break horn: These stakes has a square tapered horn on one side and a round tapered horn on opposite side. It is used for shaping round and square surfaces, bending edges and making corners.

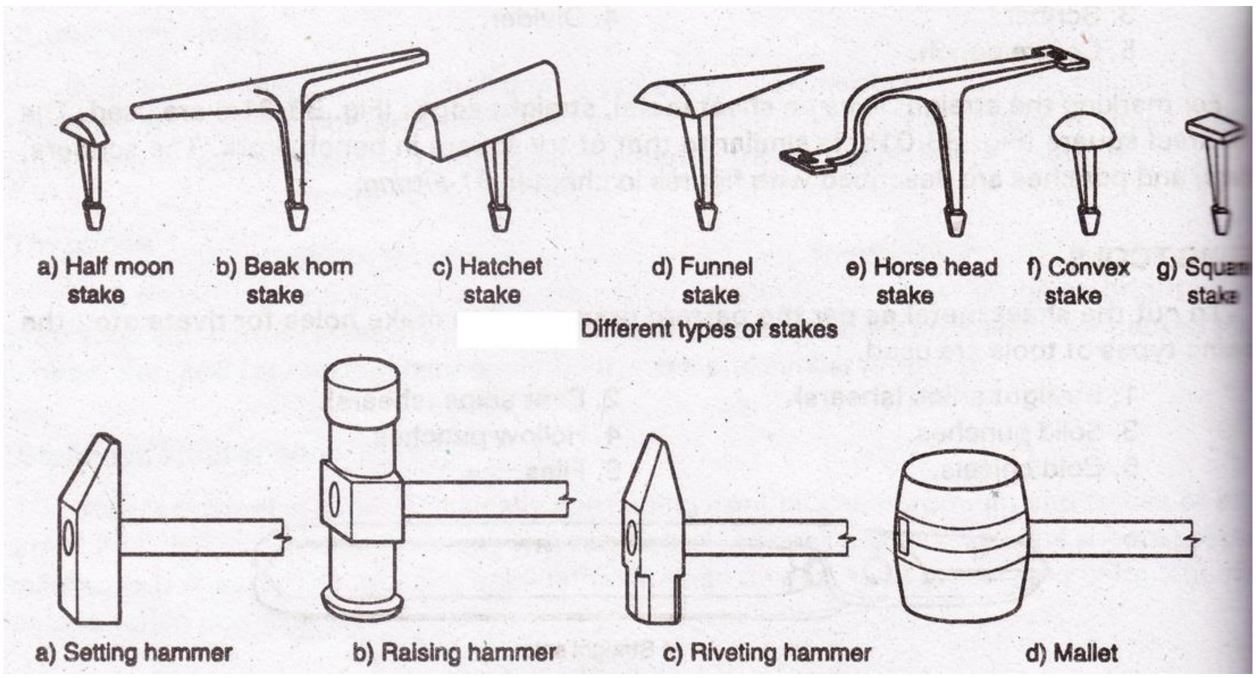
Conductor stake: These stakes has two cylindrical horns having different diameters. It is used for forming pipes and cylindrical pieces.

Funnel stake: It is used for forming conical shapes and for making wire rings.

Hatchet stake: It has a horizontal sharp straight edge and can be used for making straight, sharp bends and for folding and bending edges.



Double seaming stake.



Different types of stakes

Hand hammers and mallets

The sheet metal worker uses a wide variety of hammers and mallets for forming shapes by different operation. The most commonly used hammers are as follows:

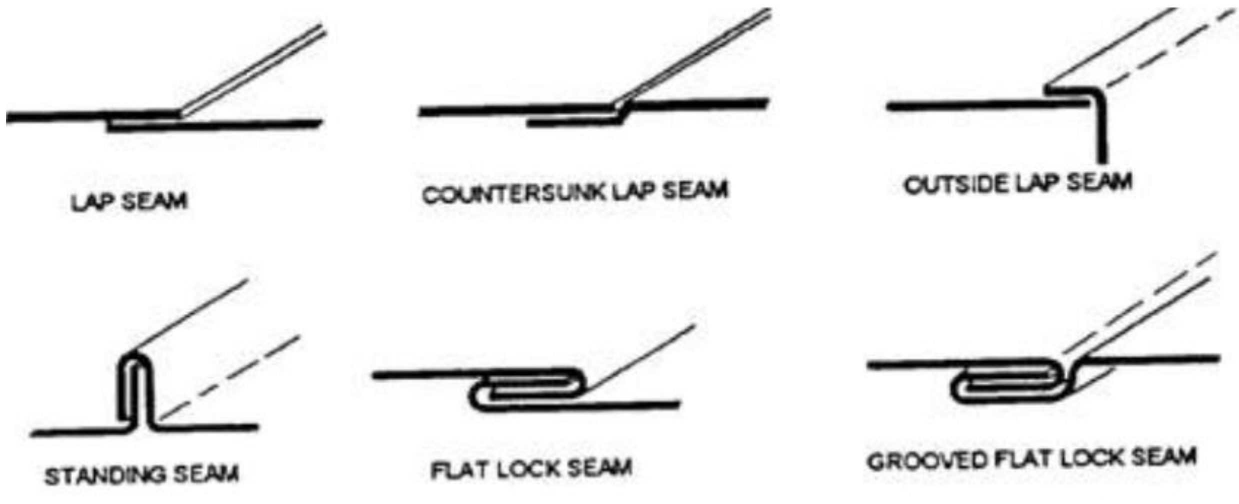
Straight-peen hammer: It has a peen end similar to its bottom size round shape and its top side is straight point. Square, slightly curved face and its peen is tapered. It is used forriveting.

Cross-peen hammer: It has a square, flat face and it is tapered on one side. It is used for setting down the edges for making a double seam.

Mallet: Mallet is generally made of wood or plastic. It is used whenever slight blows are required. Wooden mallets do not damage the surface.

Wire Gauge: The thickness of sheet metal is preferred in numbers known as the standard wire gauge (SWG). The gaps in the circumference of the gauge are used to check the gauge number as shown below.

Sheet metal joints: Various types of joints are used in sheet metal work to suit the varying requirements. Some commonly used sheet metal joints and folded edges are shown below. These are self-secured joints, formed by joining together two pieces of sheet metal and using the metal itself to form the joint.



SAFETY PRECAUTIONS

• Never carry tools in pockets.

• Do not try to hold the sheets with bare hands.

• Do not remove any guards on squaring shear.

• Care should be exercised when working on squaring shears. Be sure that the fingers are away from the shearing blade.

• Never use a soldering iron with a loose handle.

• Never touch a soldering iron to see its hotness. The safest method is to touch the iron to solder. The melting of solder indicates the correct temperature

• Be careful when cutting out a pattern. Remove scrap metal to avoid injuries.

Exp.No : 7 (B)	**Rectangular Tray – Sheet Metal Work**
Date :	

Aim

To make a rectangular tray.

Tools and materials used

Steel rule, Scriber, Divider, Mallet, Stakes, Try square, snip straight (Tin cutter) Bench shear, file flat smooth, Nylon hammer, Tin sheet piece.

Materials used

Galvanized iron sheet 28 SWG.

Drawing

See Diagrams

Procedure

1. For developing the surfaces (lying out) draw plan, front view and end view of the required open rectangular box as shown is diagram.
2. Extend all the lines and cut these lines according to the height of the tray (i.e. 30 m).
3. Addition strips of stocks are given along the edges for single hem allowance (6 mm).
4. All the four corner triangles are cut as shown in diagram for joint making.
5. Perform the operation of cuttings, shearing edges, hand forming, edge forming, joint making and bending in to rectangular tray by using above mentioned sheet metal tools by.

   I. Square folding along 12, 23, 34, 41 lines.

   II. Square folding of 15, 26, 37, 48, 2-10, 3-11, 19, 4-12,

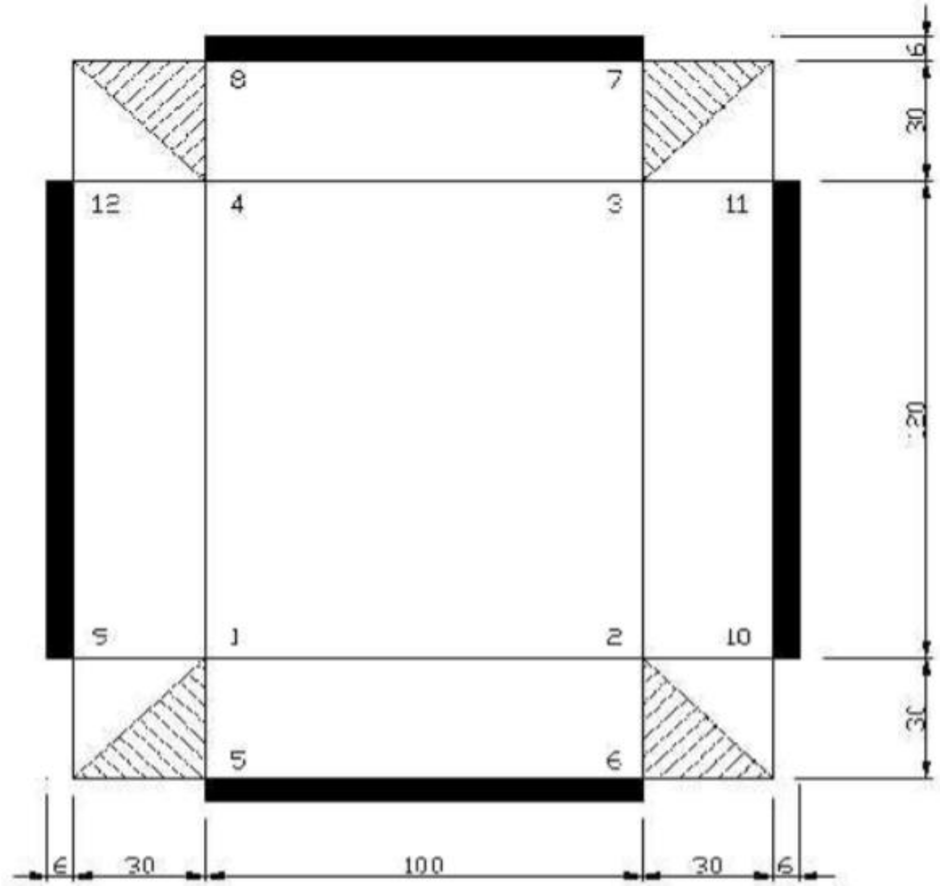
   III. Square fold for Hem 56, 78, 10, 11, 9-12.

1. File the sharp edges with a smooth flat file

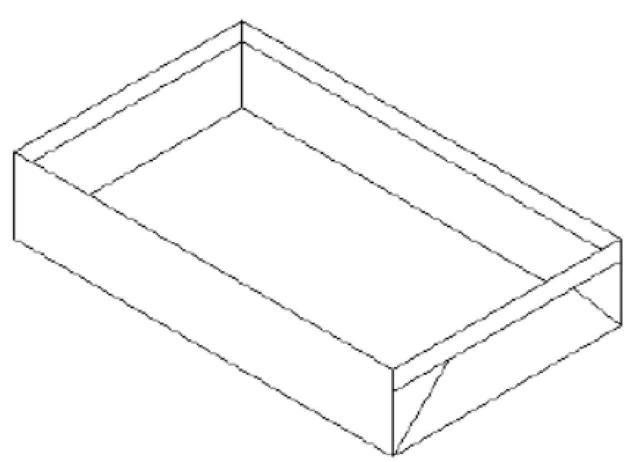
Safety Precautions

1) Take precautions while working on sharp edges of sheets to avoid injury.
2) Appropriate cutting tools and machines must be used fro cutting tin sheets.
3) Avoid using blunt cutting tools.
4) Extra allowance must be provided in the sheets while cutting so that finished product is of correct size and finish.

Result

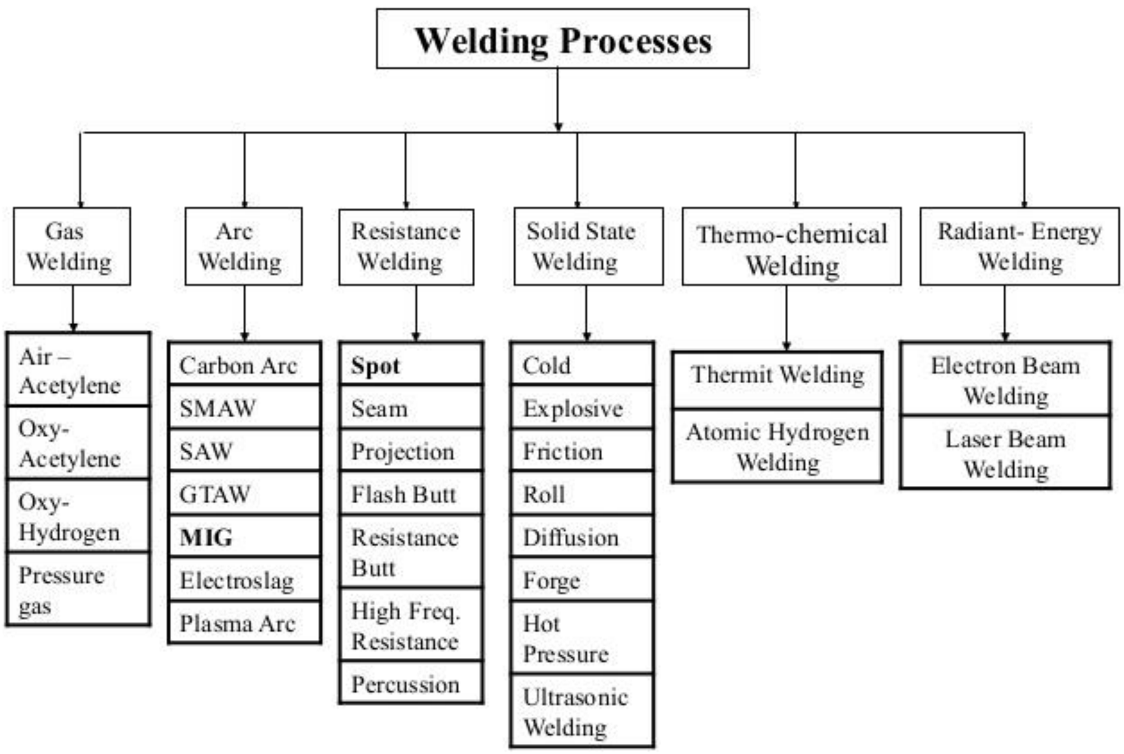


Black portion is to be bend (hem).
Hatched portion is to be cut out.
All Dimensions are in mm



Exp.No : 8 (A)	**Welding Introduction**
Date :	

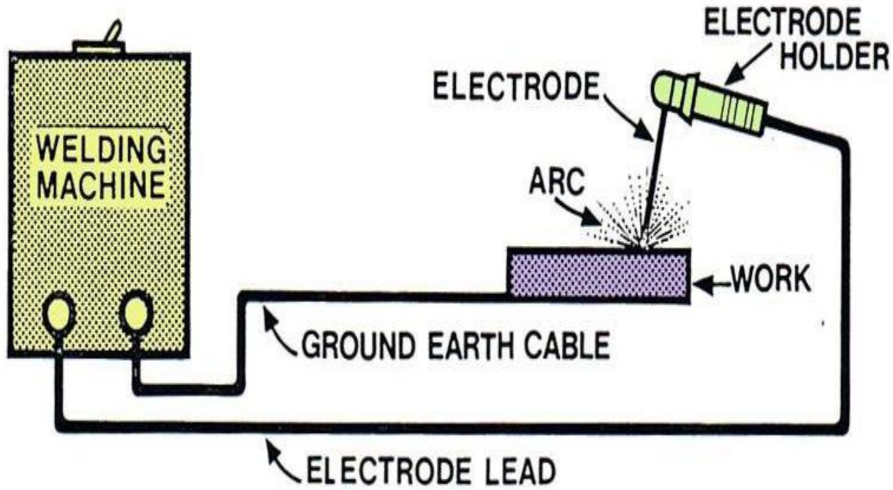
Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction. The various types of welding processes are lised in the below figure. How ever in this lab course we work in only gas welding and electric arc welding.



Electric arc welding

Arc welding is the welding process, in which heat is generated by an electric arc struck between an electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes through ionized gas. Any arc welding method is based on an electric circuit consisting of the following parts

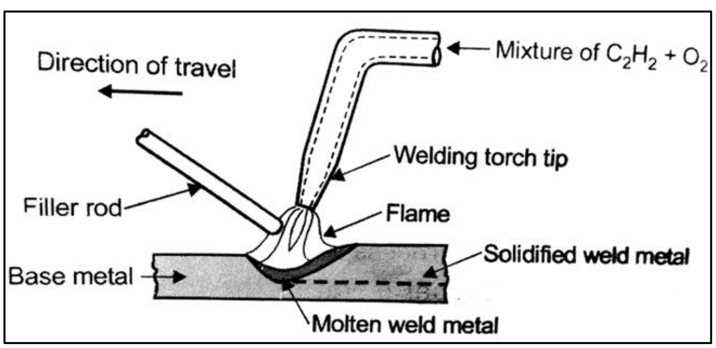
- Power supply (AC or DC);
- Welding electrode;
- Work piece;
- Welding leads (electric cables) connecting the electrode and work piece to the power supply.

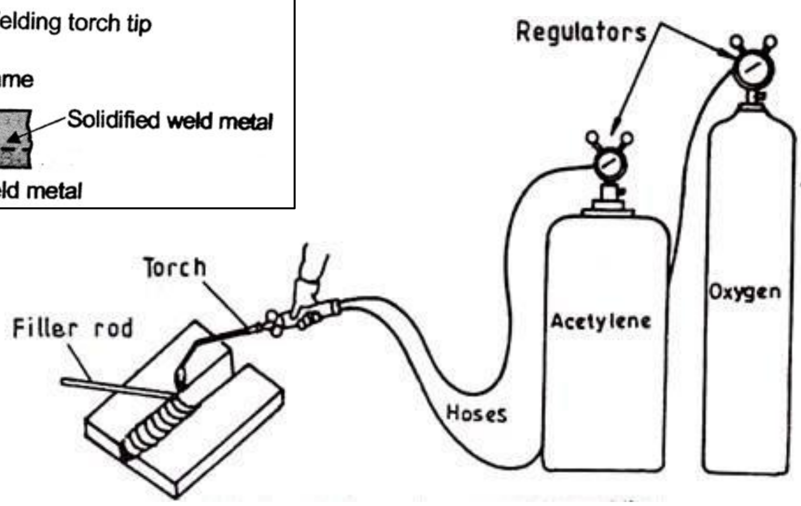


Arc welding set up

Gas Welding

In gas welding process, a joint is established by fusing the material near the region of joint by means of a gas flame. The common gas used is mixture of oxygen and acetylene which on burning gives a flame temperature of 3300 C. A filler rod is used to feed molten material in the gap at the joint region and establish a firm weld. The flame temperature can be controlled by changing the gas composition i.e. ratio of oxygen to acetylene. The color of flame changes from oxidizing to neutral to reducing flame.





Gas Welding

Exp.No : 8 (B)	**Lap Joint and Butt Joint - Arc Welding**
Date :	

Aim

To make a double lap joint and butt joint, using the given mild steel pieces and by arc welding.

Material used

Mild steel pieces of dimension .

Tools and equipment used

1. Arc welding machine,
2. Mild steel electrodes,
3. Electrode holder,
4. Ground clamp,
5. flat nose Tong,
6. Face shield,
7. Apron,
8. Hand gloves,
9. Metallic work Table,
10. Bench vice,
11. Rough flat file,
12. Try square,
13. Steel rule,
14. Wire brush,
15. Ball peen hammer,
16. Chipping hammer.

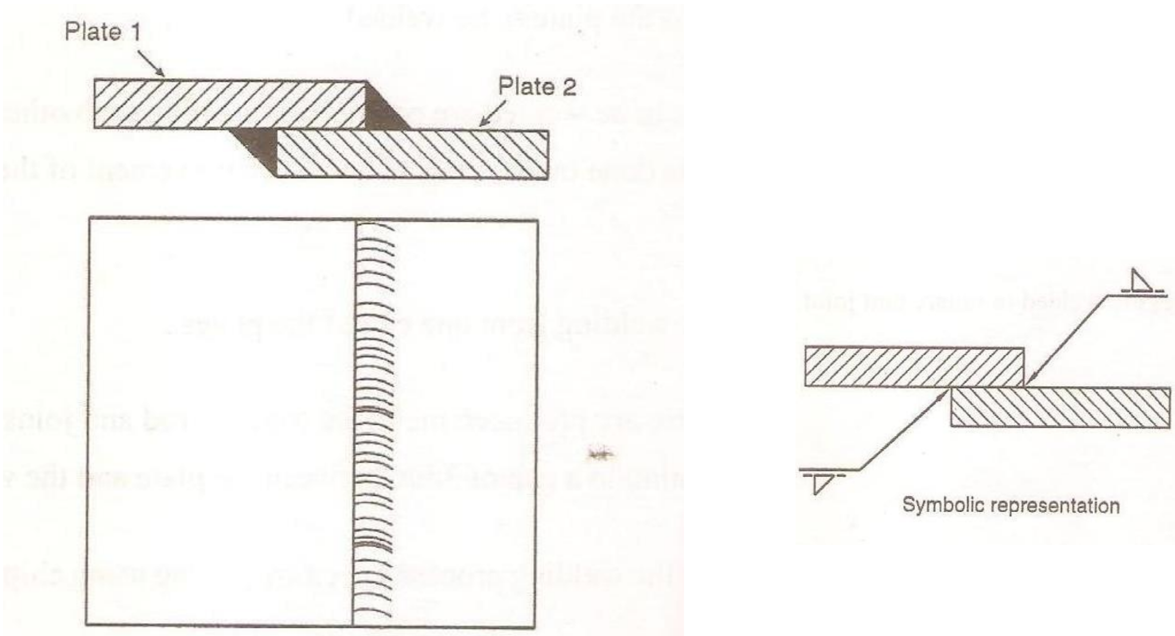
Operations to be carried out

1. Cleaning the work pieces
2. Tack welding
3. Full welding
4. Cooling
5. Chipping
6. Finishing

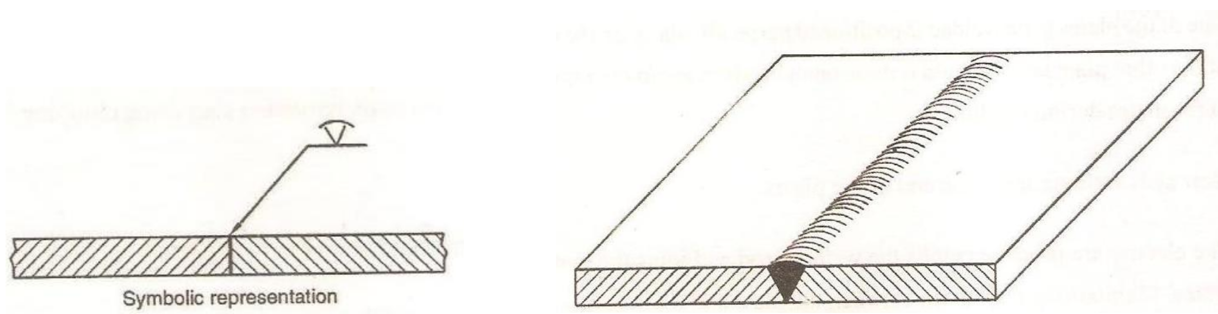
Procedure

1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.
2. Remove the sharp corners and burrs by filing or grinding and prepare the work pieces.

3. The work pieces are positioned on the welding table, to form a lap joint or a V Butt joint as required as shown in the above figure.



Lap joint



V – Butt joint

4. The electrode is fitted in to the electrode holder and the welding current is set to a proper value.

5. The ground clamp is fastened to the welding table.

6. Strike the arc and make tacks at the both ends to hold the metal pieces together duringthe welding process.

7. Welding is then carried out throughout the length of the lap joint, on both the sides.

8. Remove the slag, spatters and clean the joint.

Precautions

1. Use goggles, gloves in order to protect the human body.
2. Maintain the constant arc length.

Result

Exp.No : 9	**Dismantle and assembly of PC**
Date :	

Each student should recognize the peripherals of the computer, the components of the CPU and its functions. Draw the CPU schematic diagram along with the setup of each system. Every student should disassemble and reassemble the PC to a working state.

Objective

To recognize the computer's peripherals, assemble and disassemble the machine.

Tools

Hand-gloves, screwdriver, needle – nose pliers

Preparation

Check if all equipment is in place.

Fig. 1 set of component srequired for assembly of a PC

1. Processor (CPU)
2. Computer Case
3. Optical Drive (DVD RW and SATA capable)
4. Memory (RAM)

5. Power Supply
6. SATA Cables
7. Motherboard (SATA Capable)
8. Processor Fan
9. Case Fan
10. Hard Drive (SATA Capable)

Procedure

1. Preparing the cabinet:

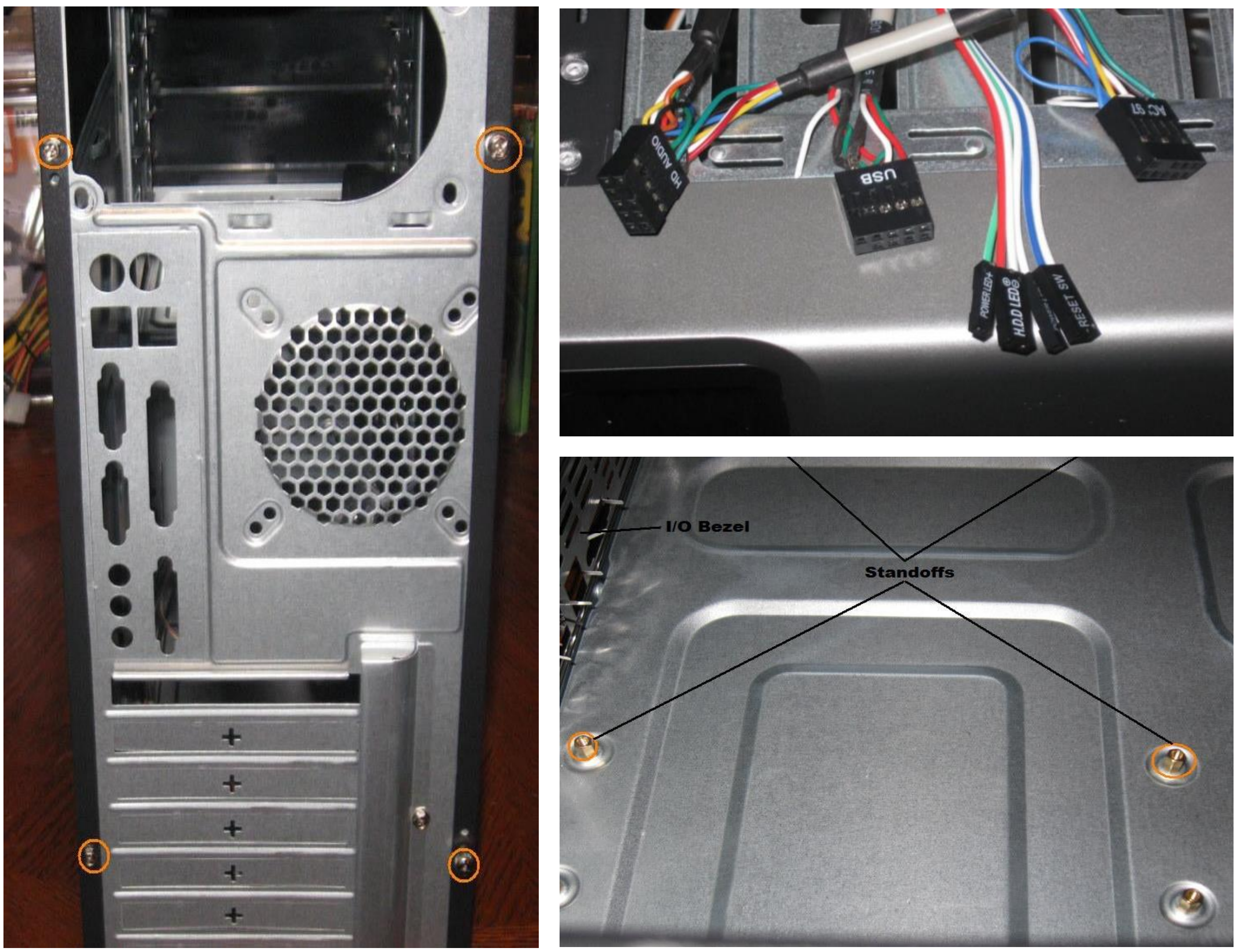


Fig. 2 Assembly of the cabinet

- Check how to open the cabinet and figure out where to fix the components.
- Determine if the necessary risers are mounted in the case.

2. Fitting motherboard:

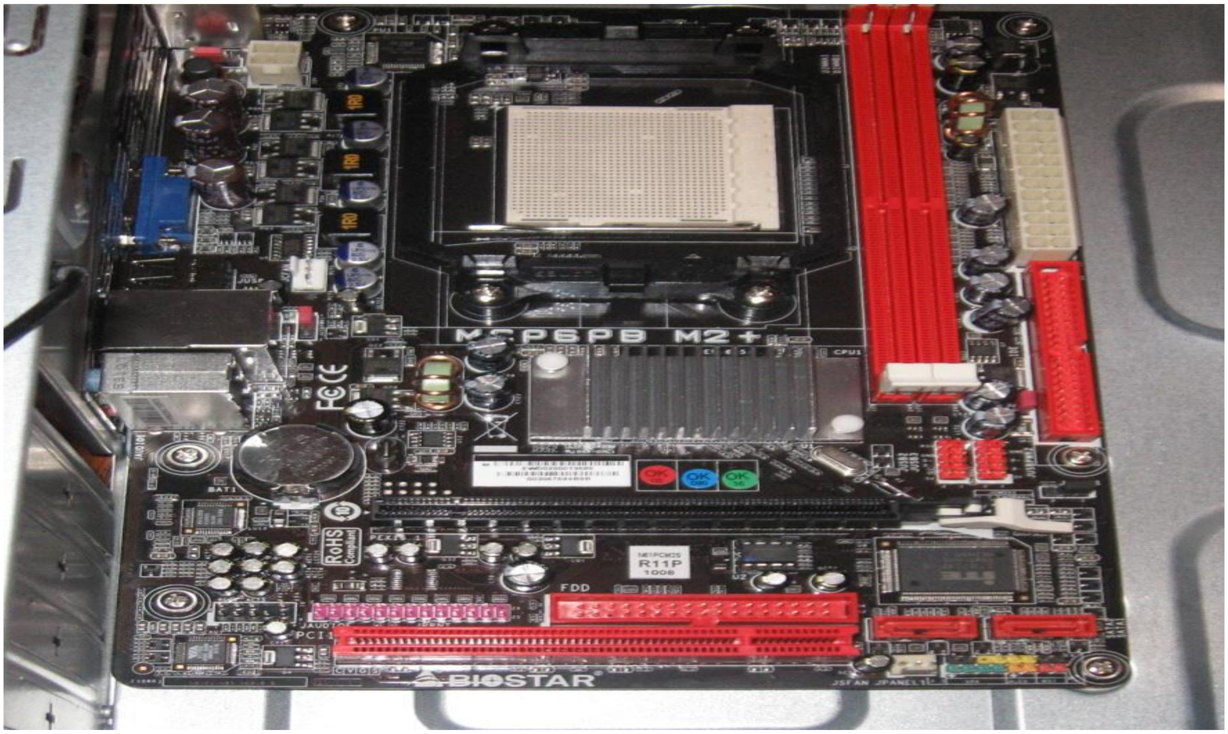


Fig. 3 Motherboard

- Line up the motherboard according to the back panel case of the cabinet (USB, PS/l, etc.)
- Install them and make the mother board sit on them and fix screws if required.

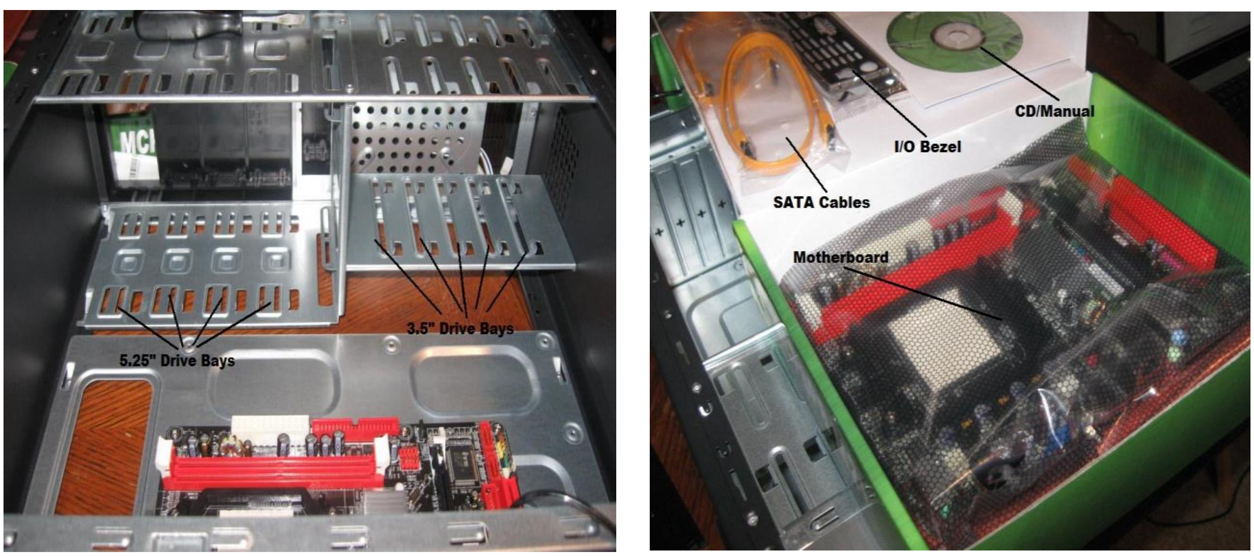


Fig. 4 Assembly of motherboard inside the CPU cabinet

3. Installing CPU:

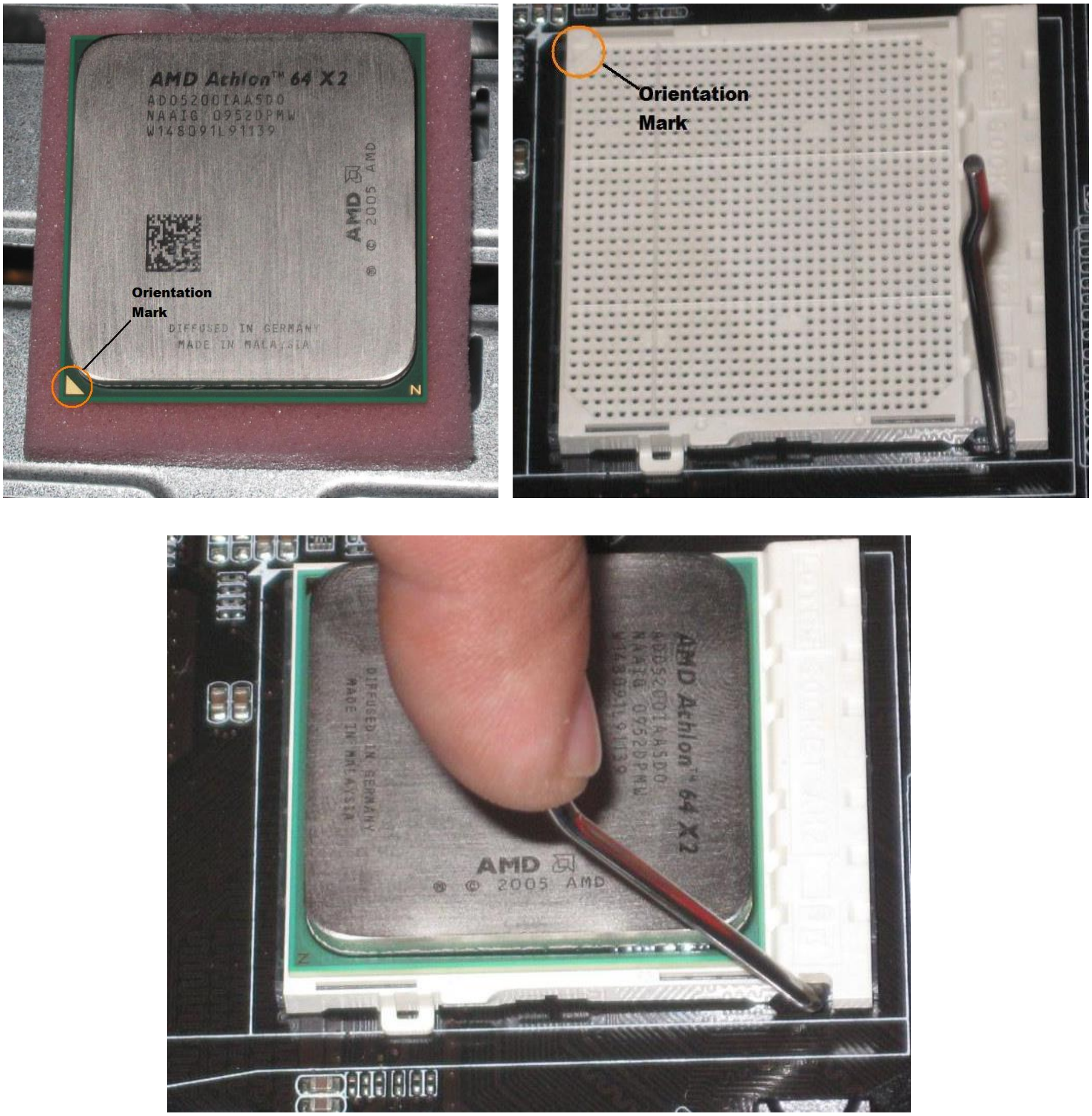


Fig. 5 Insertion of processor with motherboard

- Raise the small lever at the side of the socket.
- Notice that there is a pin missing at one corner, determine the direction to fit in the processor.
- You should not force the CPU. When inserting it. All pins should slide smoothly into the socket.
- Lock the lever back down.

4. Installing CPU fan:

- Install the heat sink over it (different type for each processor). Heat sink /CPU fan.

5. Fitting the RAM:

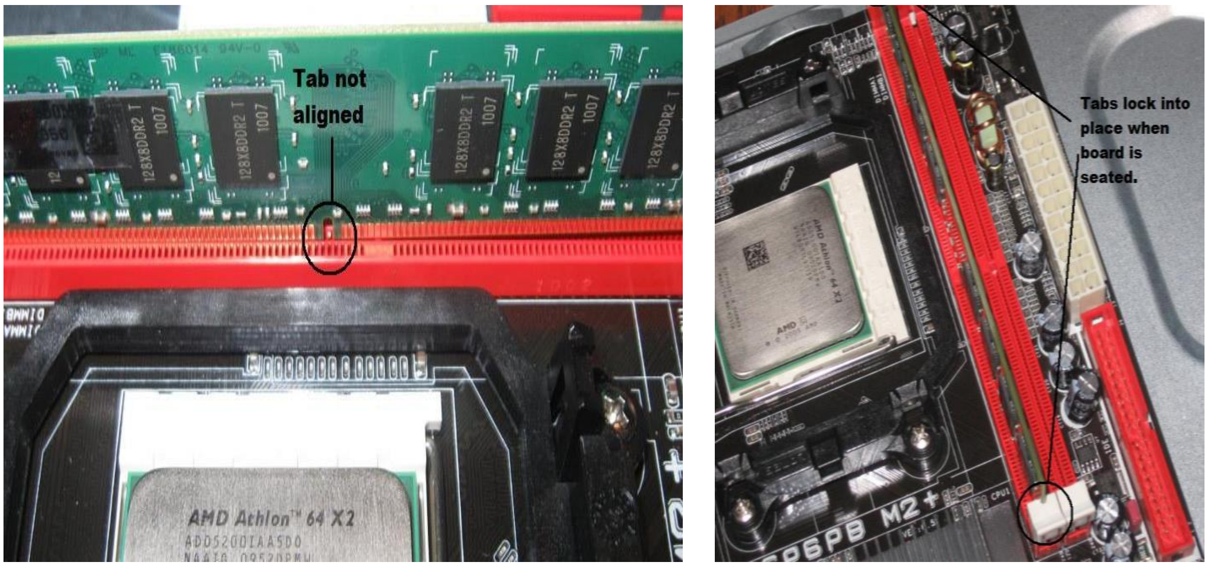


Fig. 6 Insertion of RAM in the mother board

- The RAM must be suitable for motherboard.
- There are currently 3 types of RAM available: a) SD RAM b) DDR SD RAM c) RD RAM.
- The mother board ‘s chipset determines which type of RAM may be used.

6. Install the SMPS and attach it to the space provided.

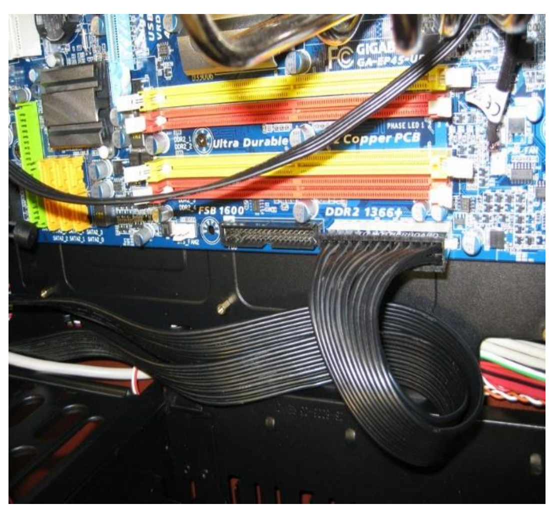


Fig. 7 Connection of SMPS with motherboard

7. Installing the ATX Power Connector • Mouse • Key board • USB • Joystick • Sound.

8. Installing the HDD:

- Place the hard disks in its slot.
- Leave some space above HDD to prevent heating.
- Check the jumper arrangement.
- Fix the screws.

9. Install the CD-ROM which is quite similar to HDD and then plug the LAN Card in respective slot in the motherboard.

10. Connecting the ribbon cables and front panel connections:

- Attach the long end of the cable to the IDEU connector on the motherboard first.

11. Powering up for the first time:

- Ensure that no wires are touching the CPU heat sink fan.
- Plug your monitor, mouse and keyboard.
- Plug in power card and switch the power supply.
- If everything is connected as it should be
    - All systems, fans should start spinning
    - U should hear a single beep and after about 5-10 sec
    - Amber light on monitor should go green
    - You will see computer start to boot with a memory check
    - Now check front LED's to see if u plugged them in correctly

The dismantling of a PC follows the same procedure as assembling the only difference being we have to unplug the connectors and remove the components slowly.

Result

Assembling and disassembling the system is completed.

Exp.No : 10 (A)	Installing OS
Date :	

1. Linux

Linux is the foundation of thousands of open source operating systems designed to replace Windows and Mac OS. It is free to download and install on any computer. Because it is open source, there are a variety of different versions, or distributions, available developed by different groups.

Objective

Installation of Linux operating system.

System Requirements

1. Processor: 2 GHz dual core processor
2. RAM: 4GB
3. Hard drive space: 25 GB of hard-drive space (or USB stick, memory card or external drive but see LiveCD for an alternative approach)
4. Graphics card: DirectX 9 or later with WDDM 1.0 driver
5. Display: VGA capable of 1024x768 screen resolution

Procedure

1. Download the Linux distribution of your choice. Linux distributions (known as "distros") are typically available for free to download in ISO format. This format needs to be burned to a CD or USB stick. This will create a Live CD or Live USB. A Live CD or Live USB is a disk that you can boot into, and often contains a preview version of the operating system that can be run directly from the CD or USB stick. Install an image burning program, or use your system’s built-in burning tool if you are using Windows 10 or Mac OS. Pen Drive Linux and UNetBootin are two popular tools for burning ISO files to USB sticks.
2. Boot into the Live CD or Live USB. Most computers are set to boot into the hard drive first, which means you will need to change some settings to boot from your newly-burned CD or USB. Start by rebooting the computer. Once the computer reboots, press the key used to enter the boot menu. If your computer doesn't give you direct access to the boot menu from the manufacturer's splash screen, it's most likely hidden in the BIOS menu. You can access the BIOS menu in the same way that you would get to the boot menu. Once you're in the boot menu, select your live CD or USB. Once you’ve changed the settings, save and exit the BIOS setup or boot menu. Your computer will continue with the boot process.
3. Try out the Linux distribution before installing. Most Live CDs and USBs can launch a "live environment", giving you the ability to test it out before making the switch. You won’t be able to create files, but you can navigate around the interface and decide if it’s right for you.
4. Start the installation process. If you’re trying out the distro, you can launch the installation from the application on the desktop. If you decided not to try out the distribution, you can start the installation from the boot menu.

5. Create a username and password.
6. Set up the partition. Linux needs to be installed on a separate partition from any other operating systems on your computer if you intend dual booting Linux with another OS. If the installation process does not give you automatic partitions, make sure that the partition you create is formatted as Ext4. If the copy of Linux you are installing is the only operating system on the computer, you will most likely have to manually set your partition size.
7. Boot into Linux. Once the installation is finished, your computer will reboot. You will see a new screen when your computer boots up called ―GNU GRUB. This is a boot loader that handles Linux installations. Pick your new Linux distro from the list. This screen may not show up if you only have one operating system on your computer. If this screen isn't being presented to you automatically, then you can get it back by hitting shift right after the manufacturer splash screen. If you install multiple distros on your computer, they will all be listed here.
8. Check your hardware. Most hardware should work out of the box with your Linux distro, though you may need to download some additional drivers to get everything working. Some hardware requires proprietary drivers to work correctly in Linux. This is most common with graphics cards. There is typically an open source driver that will work, but to get the most out of your graphics cards you will need to download the proprietary drivers from the manufacturer. In Ubuntu, you can download proprietary drivers through the System Settings menu. Select the Additional Drivers option, and then select the graphics driver from the list. Other distros have specific methods for obtaining extra drivers. You can find other drivers from this list as well, such as Wi-Fi drivers.
9. Start using Linux. Once your installation is complete and you’ve verified that your hardware is working, you’re ready to start using Linux. Most distros come with several popular programs installed, and you can download many more from their respective file repositories.

Result

Installation process of Linux OS is learnt.

2. Windows

Windows 10 is a series of operating systems developed by Microsoft and released as part of its Windows NT family of operating systems. Windows 10 makes its user experience and functionality more consistent between different classes of device, and addresses most of the shortcomings in the user interface that were introduced.

Objective

Installation of Windows Operating system.

System Requirements

1. Processor: 1 gigahertz (GHz) or faster processor or System on a Chip (SoC)
2. RAM: 1 gigabyte (GB) for 32-bit or 2 GB for 64-bit
3. Hard drive space: 16 GB for 32-bit OS 32 GB for 64-bit OS
4. Graphics card: DirectX 9 or later with WDDM 1.0 driver
5. Display: 800x600

Procedure

1. Power up your laptop.
2. Insert your Windows installation disc into your optical drive. If you don’t have access to an optical drive, you will need to create a bootable USB installation disc. If you’re working with a bootable USB installer plug it into an available USB port.
3. Reboot your laptop.
4. While powering up, depending on your laptop, you should tap either the ESC or F2 or F8 or F10 or Del key in order to get into BIOS. You can skip to step 8 if you know which key brings up the boot order for your laptop instead of having to sift through BIOS. If you do find the key to select your boot device order/options, selecting the device you want as primary boot will remain that option until the next boot up.
5. Upon entering BIOS you will need to look through your bootable device options and the order in which they’re in. This should be found in the advanced or Boot section towards the end of the listed tabs. You may even need to enable an option whereby BIOS will see your USB drive as a removable disk/CD.
6. Choose to have your optical drive or the USB drive as the primary booting device, depending on which media you’ve chosen to install Windows 8.
7. Move to Exit, save settings and then wait for the laptop to reboot with the new settings.
8. You should be greeted with a screen allowing to choose your language of installation, the time and currency format as well as the keyboard or input method. This is known as the Setup Screen.
9. Click on Next.
10. Click on Install Now.
11. Input your activation key in the space next to the keyboard icon.

12. Choose “Custom: Install Windows Only” to perform a clean install. Please be forewarned that this action will tell the installer to remove everything on the drive you wish to install (following up).
13. Choose the partition/drive/disc you want to install your OS. You should be able to identify the drive you want to install on after you inspect the Total size of the drive in question.
14. Click on Next.
15. You should now see a screen whereby the OS has begun installation. This process should take about a few minutes to about an hour depending on if you’ve got an SSD or and HDD or an SSHD on your laptop.
16. Go back into BIOS when the installation initializes a reboot and make sure the primary boot device is set to Windows Boot Manager.

Result

Installation process of Windows OS is learnt.

Exp.No : 10 (B)	Formatting and partition of disk
Date :	

Formatting

Formatting a hard drive means to delete all the data on the drive and set a file system to prepare an available space for the operating system. Disk formatting is the process of preparing a data storage device such as a hard drive, sloid state drive for initial use.

Partition

Disk partitioning (or disk slicing) is the creation of one or more regions on secondary storage, so that each region can be managed separately. These regions are called partitions. It is typically the first step of preparing a newly installed disk, before any file system is created.

Objective

To format and make partitions of the disk

Tools

PC with hard disk installed/connected

Procedure:

Formatting the disk (Windows 10)

1. Open Disk Management by typing “Create and format hard disk partitions”.
2. From the list right click on the desired drive and click “Format” and then click “Yes”.
3. In the new window, name the drive in the box by “Volume Label:” if you want. For example: “Storage” or “Second Drive”. Uncheck the “Perform a quick format” box.
4. Click “OK” on the dialog box. Again click “OK” in the new confirmation box.
5. Wait until the status of the drive will change from “Formatting:” to “Healthy:”.

Formatting the disk (Mac OS)

1. Click “Go” and select “Utilities”. Open the Disk Utility program.
2. Select the drive from the list on the left. Click the “Erase” tab.
3. Choose the file system “Mac OS Extended (Journaled)”. And give the drive a name.
4. Click “Erase” to begin the formatting the drive.

Formatting the disk (Linux)

1. Open terminal and type the command sudo fdisk -l. This will display the disks connected to the system.
2. Select the desired disk which need to be formatted (e.g., sdb). Type sudo fdisk /dev/sdb
3. Press “p” then enter and press “n” then enter. Press “p” and then enter “1”. A partition will be created.
4. Enter the command sudo mkfs.ext4 /dev/sdb. When asked type “y”. All the partitions in the sdb drive will be formatted.

Partition of disk (Windows 10)

1. Open Disk Management by typing “Create and format hard disk partitions”.
2. From the list choose the disk from which you want to make a partition.
3. Right click the Un-partitioned space in the bottom pane and select “New Simple Volume”.
4. Enter the size in MB (for example: 204800 MB for 200 GB) and click next and you are done.

Partition of disk (Mac OS)

1. In the Disk Utility app, select a volume in the sidebar, then click the Partition button in the toolbar.
2. Click Partition after reading the information in the Apple File System Space Sharing Dialogue.
3. Click the Add button “+” below the pie chart. Give a name to the volume in the Name field.
4. Click the Format pop-up menu, choose a file system format. Modify the size of the volume.
5. Click Apply. Click Partition in the Partition Device dialogue.
6. After the operation finishes, click Done.

Partition of disk (Linux)

1. Open terminal, type sudo parted -l. It displays the disk names.
2. Select the disk in which you want partitions (e.g., sdb disk). Type sudo parted /dev/sdb
3. To create partition table type mklabel gpt and type Yes to execute. Type print to review the partition table.
4. To create partition type mkpart primary ext4 1MB 1855MB. Type print to review the newly added partition. Here primary is the name of our partition.
5. To save the commands and quit, type quit command.

Result

Formatting and partitioning of disk are learnt.