AIM OF THE EXPERIMENT 1

Familarity with electronic components and devices

EQUIPMENTS REQUIRED

1. Resistors
2. Capacitor
3. Diode(PN diode & zener diode)
4. Transistor
5. Digital Multimeter

STUDY OF DIFFERENT RESISTORS AND COLOUR CODING:

Resistors are very important part of every electronics and electrical circuits. Resisters are passive components as they are not capable of amplifying or processing an electrical signal. The component which offers an opposition to electric current flow is known as resistor and their values of resistance are expressed in ohms. The ohm is denoted by the Greek letter omega Ω.

They mainly categorized as fixed and variable resistors.

FIXED RESISTORS

The resistors of this category are fixed means their values cannot be altered. Its fixed value can change with ±1% or ±5% or ±10% or ±20% of its fixed value.

The resistors may also be classified as Linear and Non-linear type.

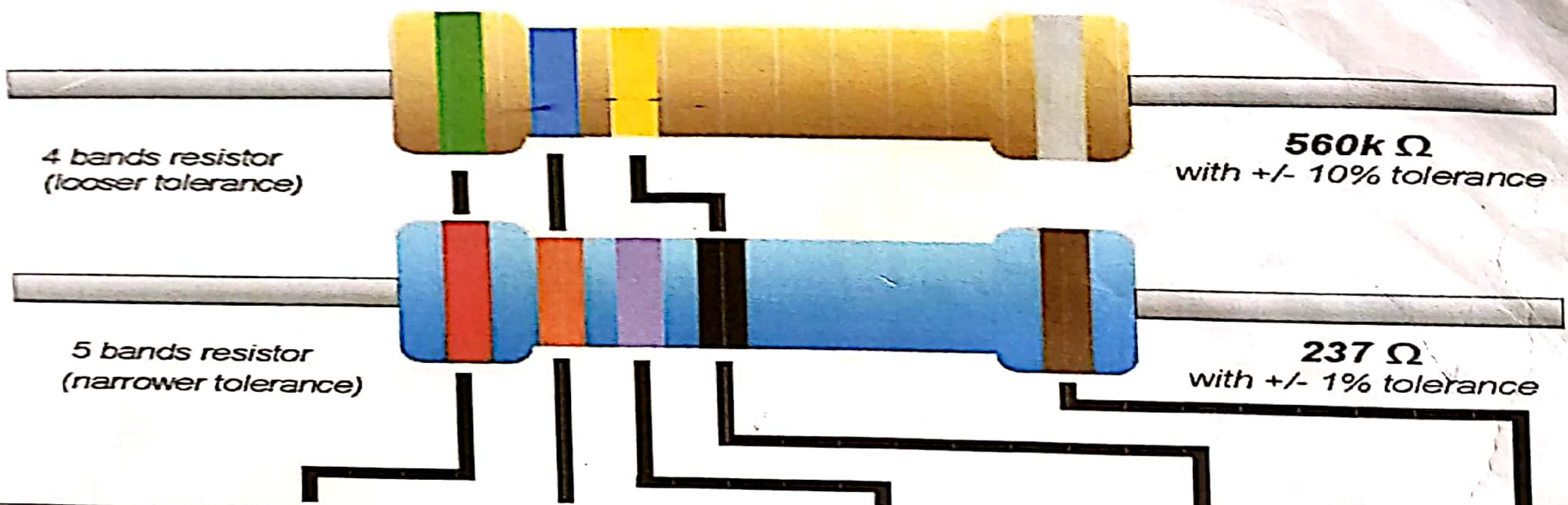
LINEAR RESISTORS

Are those resistors in which current flow is proportional to the voltage applied across it.

NON-LINEAR RESISTORS

Are those resistors in which current flow is proportional to the change in voltage across it. Such resistors are thermistors, VDR, LDR etc.

Resistor Color Code



Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

IMPORTANT TERMS RELATED TO RESISTORS

RESISTANCE

The value of resistor is expressed as resistance in ohms. Resistance values in hundreds of ohms is expressed in ohms, in thousand of ohms is expressed in kilo ohms, millions of ohms in Mega ohms. The nominal values of resistors are generally specified at room temperature of 25°C.

TOLERANCE

Tolerance and accuracy have same meaning. Accuracy is the tolerance to which the value of the resistance is made.

It expresses the maximum deviation in resistance from its nominal value. For example, if a 100 ohms resistor has ±5% tolerance we mean that its value can lie between 95 ohms to 105 ohms.

Resistor are available with various tolerance such as ±20%, ±10%,±5% in general and more precise with 1% or 2% or 0.5%. the tolerance is indicated by means of 4th colour band on resistor.

STABILITY

The resistor value once manufactured should not change by any means say by temperature, humidity or moisture. A resistance is said to be more stable if its value does not alter from its minimal value. This property is called as stability.

The term stability and tolerance should not be confused. For example a resistor of 1000±10% may have its value in between 900 ohms to 1100 ohms. But the same resistor may have its value as 985 ohms; this will try to remain constant in spite of its long use. This will be referred as stability.

As such the carbon composition resistor are less stable, carbon film resistors are fairly stable and metal films and wired wound resistors are most stable.

CARBON FILM RESISTANCE:

They are also called as cracked carbon film resistor. Thus resistor is manufacturing by deposition a carbon film by decomposing a suitable hydrocarbon vapour at high temperature on a ceramic substrate. The carbon film so produced becomes the integral part of the ceramic rod and highly stable film. The thickness of the film is controlled by various factors.

CAPACITOR

The capacitors are available in fixed and variable nature. These are classified accordingly to their dielectric. They are available in various shape and sizes.

MICA Capacitor

The thin sheet of mica ranging from 0.125 – 0.25mm is placed between the electrodes of copper on top lead foil of thickness 0.00625mm.

ELECTROLYTIC Capacitor

An electrolyte Capacitor used a very thin film of aluminium or titanium oxide as dielectric formed by an electrostatic process. They are available in form of polarized as non polarized type.

Non polarized capacitor are used in fans, ACs, Motors for self control start as well as improvement of power factor in electric circuit .Such capacitors cannot be used in AC circuits and to be connected with appropriate polarity in DC circuit.

The positive or plus sign is presented on the package and normally for fresh capacitor .This lead is longer than the negative terminal. The capacitor gets short circuited due to wrong connection .It may burn if applied voltage is exceeding the rating of capacitor.

TYPES OF SEMICONDUCTOR DEVICES

Semiconductor devices are versatile units employed in a variety of applications in electronic equipments , amplifiers, oscillators, modulators, voltage and current sources, electronic switches ,voltage shifters and variable resistors. They are also employed as energy converters (for example light emitting diodes) and generating logarithmic and antilogarithmic functions. Semiconductor devices can be broadly classified into two areas.

1. BIPOLAR

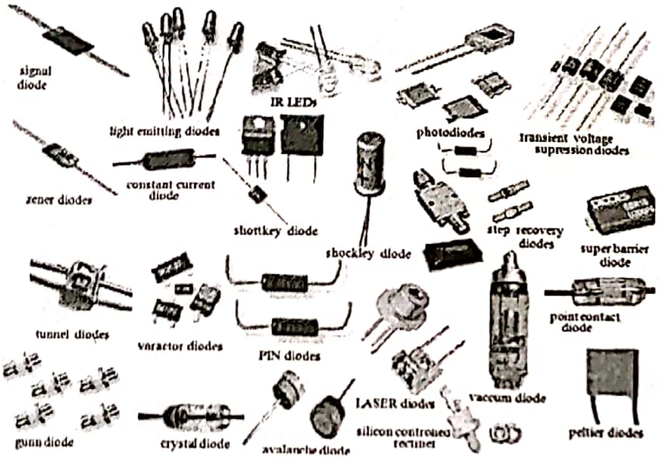
In bipolar devices the action of device depends upon the flow of type of charge carrier across forward or reverse biased PN junctions .For example in NPN bipolar transistor the flow of electrons across the reverse biased collector base junction is controlled by the forward biased base emitter junction. As electrons move into the base, some recombine with holes but the majority diffuse across the base and are swept up by the collector. Commonly used bipolar devices are transistors, diodes, unijunction transistors, thyristors, logic's such as TTL and linear IC'S.

2. *UNIPOLAR*

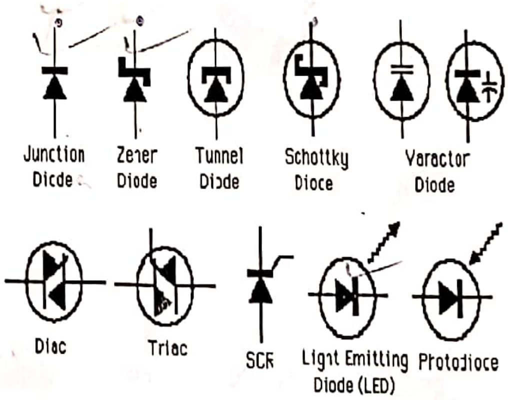
Unipolar devices use only majority carriers for current flow and this current is controlled by an electrostatic field , say between gate and source or gate and substrate. Typical examples of unipolar devices are junction FET'S ,MOSFET'S, CMOS LOGIC and linear IC'S.

DIODES

The cathode and anode ends of metal encased diodes can be identified by the diode symbol marked on the body. In case of glass encased diodes the cathode end is indicated by a strip, a series of strips or a dot. figure shows various shapes and biasing of diodes.



Types of Diode



A diode can be conveniently checked with an ohmmeter by measuring its forward and reverse resistance. Conventional diodes normally show a low value of forward resistance and a very high value of reverse resistance.

NORMAL DIODE

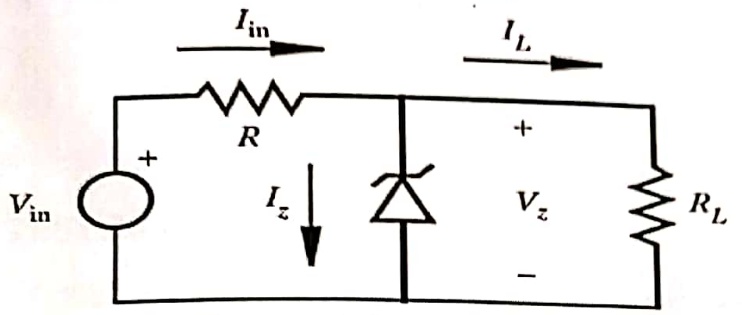
It is basically of two types, silicon diode or germanium diode. But the most convenient diode is silicon diode because Silicon diodes have a greater ease of processing, lower cost, greater power handling & less leakage . Silicon diode have cut-in voltage of 0.65V and that of Ge diode is 0.3V

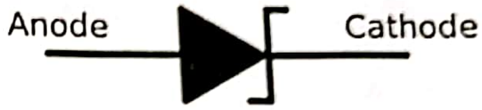
ZENER DIODE

A silicon diodes has a very low reverse current, say 1µa at an ambient temperature at 25°C.However at some specific value of reverse voltage a very rapid increase occurs in reverse current. This potential is called breakdown avalanche and may be as low as 1 volt or as high as several hundred volts depending on the diode construction.

A zener diode has very high resistance at bias potentials below the Zener voltage .The resistance can be of several megohms.

At Zener voltage the Zener diode suddenly shows a very low resistance. say between 5 and 100Ω. A Zener diode behaves as constant voltage source in the Zener region of operation as its internal resistance is very low. The current through the zener diode is then limited only by the series resistance(see fig.).The value of series resistance is such that the maximum rated power rating of the Zener diode is not exceeded.





(fig: zener diode as regulator)

TESTING PROCEDURE

1. A Zener diode can be checked with an ohmmeter below the Zener voltage, when its operation is similar to silicon diode.

2. At Zener voltage it is tested by measuring the voltage appearing across it, when it is in the circuit. A simple arrangement is shown in figure.

TRANSISTORS(NPN &PNP)

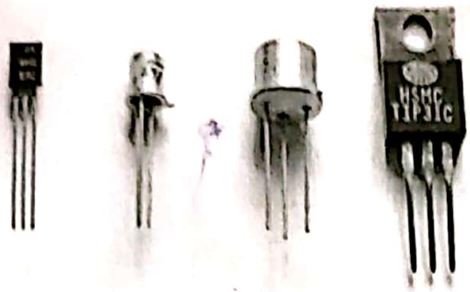
The most commonly used semiconductor is the transistor. In troubleshooting transistor circuits the following point should be kept in mind;

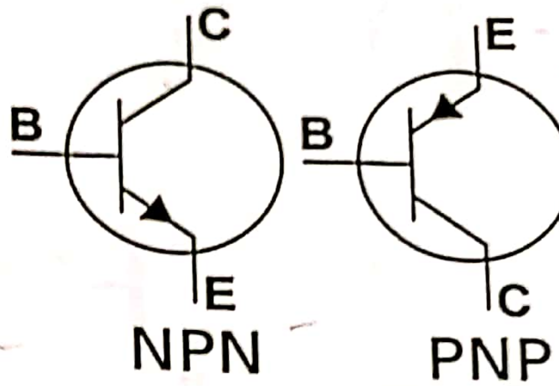
1. NPN& PNP devices are basically "off " devices while vacuum tubes are "on" devices.

2. Transistors are made up of two diodes a base emitter diode a base collector diode.in normal amplifier operation the base emitter diode is forward biased the base collector diode is reverse biased.

3. Shorting base to emitter turns off transistors, while forward biasing base emitter turns on transistors.

4.All transistors have leakage current across the reverse biased base collector diodes. for silicon transistors this current is several nanoampere . In germanium transistors the leakage current may even be several microampere .fig shows different designs, symbols and terminals for different transistors.





TESTING PROCEDURE

If the terminal marking in a bipolar transistor is not known and also identification of the devices has been erased .it is possible to identify the base emitter and collector terminals and the type of transistors using an ohmmeter. To do so proceed as follows

1.Make resistance measurement between each all of leads in both the forward resistance and reverse resistance directions. A resistance below 250Ω shows the ohmmeter is forward biasing ϕ junction.The highest forward is obtained between the emitter and collector leads. The third lead which is not connected to the ohmmeter is the base lead.

2. Next resistance measurement is made between the identified base and one of the other leads. If the ohmmeter indicates forward resistance when the negative lead of the ohmmeter is connected to the base of the transistor is a PNP type. The transistor NPN type if the forward resistance is indicated with the positive lead of the ammeter connected to the base.

3. To identify which of the two unknown leads is the collector and which emitter the two resistance measurements are made between these two leads ,reversing the ohmmeter polarity for the second measurement. carefully observe the polarity that gives the lower resistance indication

(a) if a PNP transistor is under test the negative lead of the ohmmeter will be connected to the negative lead

(b) in case of NPN transistor , the positive lead of the collector lead

One cannot, however, easily determine which electrode is the drain and which is the source, but these electrodes are to some extent electrically interchangeable.

MOSFET TESTING PROCEDURE

1. An ohmmeter can be used to check the MOSFET.

2.The gate-to-source insulation is checked with the highest range of the ohmmeter for NPN and PNP MOSFET.

3. A practically infinite reading is normally obtained for both polarities of test voltage.

4. The drain-to-source resistance normally has a comparatively low value and the ohmmeter readings are the same regardless of test voltage polarity.

LIGHT EMITTING DIODE(LED)

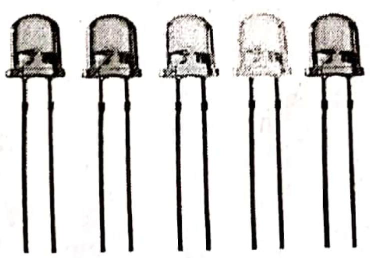
The light emitting diode is an opto electronic device. When forward biased ,this diode emits light of a particular colour depending upon the band gap, LEDs are made of gallium arsenide(GaAs), gallium arsenide phosphide(GaAsP) and gallium phosphide(GaP).these materials are doped to get N type and P type materials. when excited the electrons jump to higher energy levels and then fold back to lower energy levels , thereby giving off energy in the form of radiation.

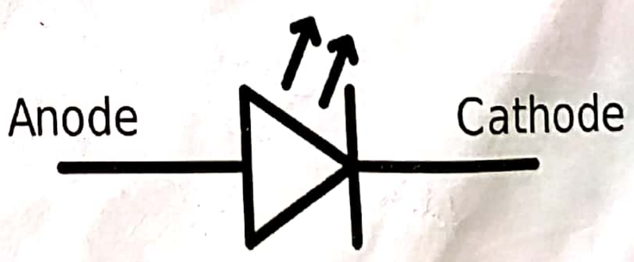
The different materials radiate the following colours of light:

1.GaAs---infrared radiation(invisible)

2.GaAsP-----red or yellow light (depending upon ratio of ingredients)

3.GaP-----red or green light





OBSERVATION TABLE

Measurement of Resistance

Sl.no	Colour code	Theoretical value	Experimental value	% of error

Measurement of Capacitance

Sl. no.	Theoretical value	Experimental value	% of error

Measurement of Diode potential

JUNCTION VOLTAGE

Sl. no.	types	~~Forward bias~~	~~Reverse bias~~
Si diode			
Zener diode			

Determination of Transistor Terminals

Sl. no	Types	specifications	V_{BE}		V_{BC}	
			~~Forward~~	~~Reverse~~	~~Forward~~	~~Reverse~~
1	PNP					
2	NPN					