UNIT-3

BASIC ELECTRICITY & FUNDAMENTALS OF ELECTRONICS

INTRODUCTION

The fact that amber, when rubbed, was capable of attracting light objects was known to the Greek 2500 years ago. Thales of Miletus became aware of this peculiar property in 600 B.C. William Gilbert (1544 - 1603), who was Queen Elizabeths physician, made further investigations and learned that many substances besides amber attracted other objects when activated by friction. He called such attractions "electric" after the Greek work "elektron" meaning amber.

In 1979 Stepehn Gray found that when a substance has been electrified by friction and then was allowed to touch another substance the power of attraction was passed on to the second substance. Seven years later, Desgauliers, pointed out that some substances possessed the ability to transmit the attractive from one point to another. He called such substances conductors. Today we call substances that do not have such property as insulators.

Charles Francis Du Fay (1698 - 1739) discovered that there were two kinds of electricity. One was produced by rubbing glass, for example, with silk; the other one resulted from rubbing a resinous substance with wool or fur. He also found that these two different kinds were capable of attracting each other.

Similar kinds of electricity on the other hand, repelled each other. Meanwhile, experiments were at work attempting to build machines which would produce more powerful effects that those demonstrated thus far; such machines began to appear around 1700. One of the first successful attempts was made by Otto Von Guericke.

The intelligent study of electrical theory with its modern applications requires a knowledge of the atom since it forms the basic foundation for all electrical principles.

ELECTRIC POTENTIAL:

"The capacity of a charged body to do work is called electric potential".

Every charged body has the capacity to do work by moving another charged body either by attraction or repulsion. The unit of electric potential is"Volt". The electric potential at a point due to a charge is one volt if, one Joule of work is done is bringing a unit charge from infinity to that point.

Electric potential (V) = Work done (W)/Charge (Q) 1 Volt = 1 Joule / 1 Coulomb

Volt: It is defined as the p.d. across a resistance of one ohm carrying a current of one Ampere.

POTENTIAL DIFFERENCE:

The potential difference (V) between two points in a circuit is electrical pressure or voltage required to drive the current between them.

The unit of potential difference is same as of Electromotive force which is volt.

RESISTANCE:

Resistance may be defined as that property of a substance which opposes the flow of electricity through it. It is represented by ”R”. The unit of resistance is ohm(Ω)

Ohm: Ohm is the resistance of a circuit in which one ampere current flows when P.D. of one volt is applied. Its bigger unit is Megohm=10^6 ohm and smallest unit is micro-ohm=10^{-6} ohm. The unit of current is ’Ampere’
Current (I) = (charge (Q)/Time (t))
1 Ampere = (1 Coulomb / 1 Second)

CURRENT:

Flow of electrons in any conductor is called current. It is represented by I. The unit of current is Ampere.

Ampere: It is a constant current which when maintained in two parallel straight conductors of infinite length and negligible cross-section separated by a distance of one meter in vacuum, produces between these conductors force equal to 2x 10^7 Newton’s per meter length.

OHM’S LAW

This law is named after the German Mathematician George Simon ohm who first enunciated it in 1827. Ohm’s law states that the ratio of the potential difference (v) between any two points of a circuit to the current (I) flowing through it is constant provided the temperature remains constant. The constant is usually denoted by resistance(R) of the circuit.
Hence R=V/I
ohms = volts / Amperes Where V=voltage between two points. I = Current flowing

R = Resistance of the conductor
I=V/R or V=IR
Ampere = volts / ohms or Volts= Amperes x ohms

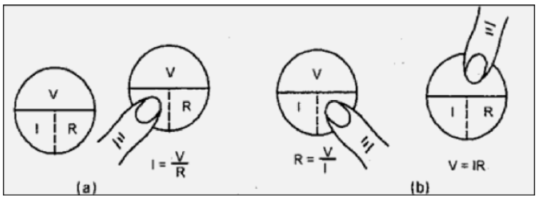


Fig.3.1: Ohms Law

Ohm’s law can be applied to an electric circuit as a whole or it can be applied to any part of it. This is an important law in electrical engineering. This law is applicable for d.c. circuitsonly.

The ohm’s law equation can be memorized and practiced effectively by using an ohm’s lawcircles as shown in Fig.

BASIC CIRCUIT COMPONENTS

Resistor, inductor and capacitor are the three basic components of a network. A resistor is an element that dissipates energy as heat when current passes through it. An inductor stores energy by virtue of a current through it. A capacitor stores energy by virtue of a voltage existing across it. The behaviour of an electric device may be approximated to anydesired degree of accuracy of a circuit formed by inter connection of these basic circuitelements.

(a) Resistor

A Resistor is a device that provides resistance in an electric circuit. Resistance is the property of circuit element which offers opposing or hindrance to the flow of current and in the process electrical energy is converted in to heat energy. A Physical device whose principle electrical characteristic is resistance is called resistor.

(b) Inductors

The electrical element that stores energy in association with flow of current is calledinductor. The basic circuit model for the inductor is called inductance. Practical inductorsare made of many turns of thin wire wound on a magnetic core or an air core. A unique feature of the inductance is that its presence in a circuit is felt only when there is a change in current.

(c) Capacitors

A capacitor is a device that can store energy in the form of a charge separation when it is suitably polarized by an electric field by applying voltage across it. In a simplest form a capacitor consists of two parallel conducting plates separated by air or any insulating material such as mica. It has the characteristic of storing electrical energy (charge) which can be fully retrieved in an electric field. A significant feature of the capacitor is that its presence is felt in an Electric circuit when a changing potential difference exists across the capacitor. The presence of an insulating material between the conducting plates does not allow the flow of d.c. current, thus a capacitor acts as an open circuit in the presence of d.c. current.

The ability of the capacitor to store charge is measured in terms of capacitance.

PROBLEMS OF OHM'S LAW

Problem 1. The current passing through lamps is 0.5 amps and the supply voltage is 250 volts. Calculate the resistance of filament lamp.

Given I=0.5 amps; V=250
voltsRequired R=?

Solution; R =V/I as per
ohms lawR=250/0.5 = 500 Ω

Problem 2. A 230 volts tester has a resistance of 23 Ω. What would be the minimum ratingof the fuse in the electric circuit for using the tester?

Given: V=230 volts
Required: I=?R=23 Ω
Solution: As per ohms law I=V/R = 230 / 23 = 10 amps

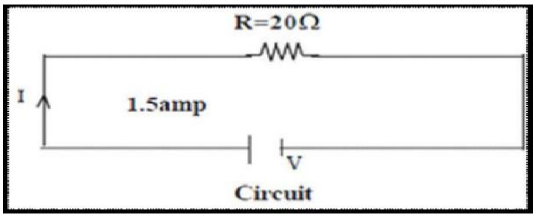
Note: the rating of the fuse means the maximum current the fuse allows to pass through it, beyond which the fuse melts, thus disconnecting the circuit.

Problem 3. An electric iron takes a current of 2.2 amps from 220 volts supply. What is it's resistance.

Given I = 2.2 amps
Required = R =?
V=220 Volts
Solution R=V/I = 220/2.2=100 Ω

Problem 4. A battery of negligible resistance is connected to a coil of 20 Ω resistance. What must be the battery e.m.f. in order that a current of 1.5 amps may flow the circuit.

Given: R=20 Ω, I=1.5
ampRequired V=?
Solution V=IR = 20 x 1.5 =30 volts



Problem 5. The potential difference between the terminals of an incandescent lamp is 220 volts and the current is 0.22 amps. What is the resistance of the lamp.

Given : P.d=220 volts ; I=0.22 amp
Required : R=?
Solution : R=V/I = 220/0.22 = 1000 Ω

LAWS OF RESISTANCE

The Resistance 'R' offered by a conductor depends upon the following factors

(1) It varies directly as its length (L) R α L
(2) It varies inversely as the cross section (a) of the conductor. R α 1/a
(3) It depends upon the nature of the material
(4) It also depends upon the temperature of the material.

Let us assume R=ρL / a where ‘ρ ‘(Rho) is a constant represents the nature of the materialand is known as specific resistance or resistivity of a material.

SPECIFIC RESISTANCE OR RESISTIVITY:

The specific resistance of the material is the resistance of a piece of unit length and unit cross section i.e., it is the resistance between the opposite faces of unit cube of thematerial.
Specific resistance is measured in ohm centimeter, or more usually, micro-ohm centimeter.

R=ρL / a where ‘ρ ‘ (Rho) is a constant

SPECIFIC CONDUCTIVITY

Specific conductivity of the material is the flow of Electrons a piece of unit length and unit cross-section i.e., it is the conductor unit cube of the material. Specific conductivity is measured in Amp - inch, Amp-Centimeter.

EFFECT OF TEMPERATURE ON RESISTANCE

The resistance of the material changes with the change in temperature. In some materials, resistance increases with the increase in temperature. Such materials are said to have positive temperature coefficient of resistance.

Eg: Copper, Aluminum etc.

In some materials, resistance decreases with the increase in temperature. Such materialsare said to have negative temperature coefficient of resistance.
Eg: Mica, Germanium. Rubber etc.

SERIES AND PARALLEL CONNECTION OF RESISTANCE

SERIES CIRCUIT:

Let each resistance has + - side. If several resistances are joined in such a way that the +ve side of resistance (assumed) is connected with -ve side of resistance and +ve side or will -ve side of the circuit is called series circuit.

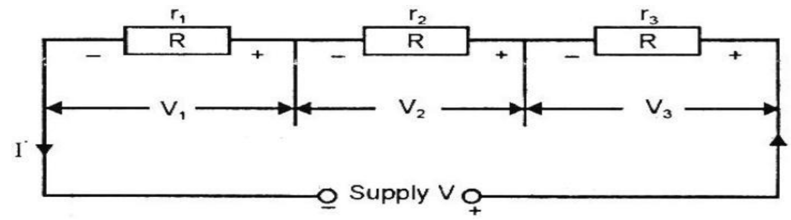


Fig.3.2: Series Circuit

In Series circuit, Current remains same in each resistance and line. Voltage drops according to the branch resistance and the total voltage will be equal to applied voltage. (See Fig.)

$$V = V_1 + V_2 + V_3$$

$$V = Ir_1 + Ir_2 + Ir_3$$

$$V = I(r_1 + r_2 + r_3)$$

or $$V/I = (r_1 + r_2 + r_3)$$

Hence total resistance $R = r_1 + r_2 + r_3$

In this way the total resistance R will be equal to the sum of all the resistance connected in series.

APPLICATIONS OF SERIES CIRCUITS

Series circuits are commonly seen in applications such as street lamps, and airport run way lamps, Another example of an everyday occurrence is lighting at temples and houses during festival and decoration of Christmas trees. When one of the lamp in the string burns out, allthe bulbs do not glow because the circuit is no longer complete for the current flow. Thefused bulb cause an open circuit for current flow. If a string contains 10 bulbs and if it is connected to a 200 volts source, 20 v will appear across each bulb. If one bulb burns out, then 200 v will appearacross the remaining 9 bulbs, and 22.2 volts will appear across each bulb. This increased voltage can burn out another bulb and so on. In the case of airport run way lamp and street lamps, normally constant current variable voltage sources are used to avoid burning of bulbs and to maintain continuous illumination. When one of the bulb burns out, a device at the lamp automatically short circuits the defective lamp, thus allowing other bulbs to glowcontinuously

The variable voltage source will automatically reduce the voltage across the circuit reducing the current flow through the lamps (normal rated current is maintained) thus preventingfurther burning out of lamps.

PARALLEL CIRCUIT

If several resistances r_1, r_2 and r_3............ are jointed in such a way that +ve sides (assumed) of all resistance are connected at one point and -ve sides at another point, as shown in Fig 3.3. the circuit is called parallel circuit.

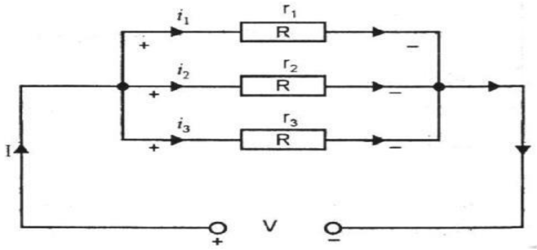


Fig.3.3: Parallel Circuit

In parallel circuit, Voltage remains same in each branch, but total current *I* divides in separate branches

Thus, $I = i_1 + i_2 + i_3$

$$I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$I = V\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]$$

$$\frac{I}{V} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Hence, the total resistance is equal to the sum of the reciprocal of individual resistances.

APPLICATIONS OF PARALLEL CIRCUITS

Parallel circuits are widely used in the light distribution circuits in homes and factories. These circuits are supplied from constant voltage - variable current sources. Parallel circuits are also used on ships for their service distribution systems, where many branch circuits are connected in parallel across the busbars.In home and factory distribution circuits, all parallel circuits are connected to the main circuit and each parallel circuit will have a fuse in it. In actual practice, almost all distribution electrical circuits are parallel circuits.

RESISTANCE IN SERIES AND PARALLEL COMBINATION

Sometimes the circuits may be neither pure series nor pure parallel, but a combination of series and parallel, may come across as shown in Fig 3.4(a) below.

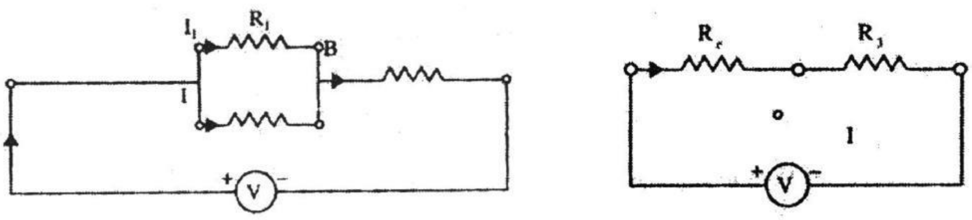


Fig.3.4: Series and Parallel combination

For such circuits, first the parallel combination of resistances R1 and R2 should be solved for finding its total equivalent resistance.

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2}$$

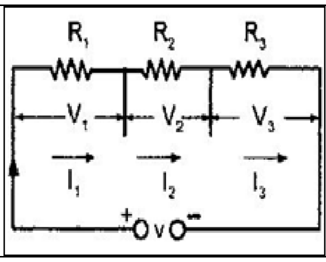
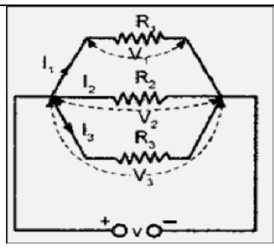
$$R_e = (R_1R_2) / (R_1+R_2)$$

Then the equivalent resistance Re and R3 are in series as shown in second Fig. Thus the total resistance of the series parallel circuit is the sum of Re and R3.

$$R_T = R_e + R3$$

PRACTICAL APPLICATIONS OF SERIES PARALLEL CIRCUITS

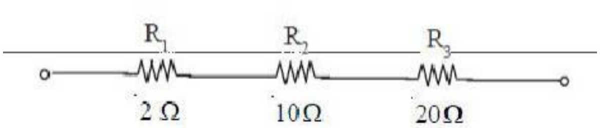
Series parallel circuits are common features of many electronic circuits. They are used in a variety of situations where different voltages and currents are required.

	Series Circuit	Parallel Circuit
Diagram		
Current	The current is same in all resistors ofthe circuit. $I=I_1=I_2=I_3=....$	The total current supplied to circuit is equal to the sum of the currents through the several branches $I=I_1+I_2+I_3+ ....$
Resistance	The total resistance equals the sumof the resistances of the separate resistors R=R1+R2+R3 +....	The reciprocal of the total or combinedor equivalent resistance equals the sumof the reciprocals of the resistances ofthe individual branch resistors $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$

SERIES & PARALLEL CIRCUIT SIMPLE PROBLEMS

Problem 1. Three resistances of 2, 10 and 20 Ωare connected in series. Find the equivalentvalue of resistance.

Given Data: R1=2 Ω, R2=10Ω, R2=20Ω

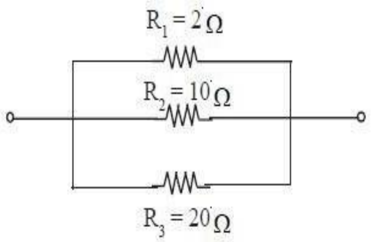


Series Circuit

R t=R1+R2+R3= 2 + 10 +20 = 32 ohms

Problem 2. Three resistance of 2, 10 and 20 □are connected in parallel. Find the equivalentresistance.

Given Data: R1=2 Ω, R2=10Ω, R2=20Ω

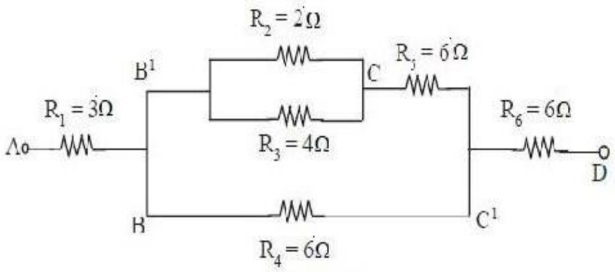


Parallel Circuit

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{2} + \frac{1}{10} + \frac{1}{20} = \frac{10+2+1}{20} = \frac{13}{20}$$

$$Equivalent\ Resistance\ R = \frac{20}{13} = 1.54\ \Omega$$

Problem3. Find the total resistance of the following circuit.



Series parallel combination

Resistance between R2 and R3

i.e. B1 and C1= 2x4 / 2+4 = 8/6 = 4/3Ω

Resistance between BB1=

Resistance between AD i.e. R1 + (R between B1C1)+R between D.

= 3 + (15/7) + 6 = 78 / 7 = 11.5 Ω

KIRCHOFF'S LAWS

The current in various branches of large network cannot be found out by ordinary methods.By application of Kirchhoff's laws, complicated networks can be solved.

Gustav Robert Kirchhoff's (1824 - 1887) a German physicist published the first systematic description of the laws of circuit analysis. These laws are known as Kirchhoff's current law (KCL) and Kirchhoff's voltage law (KVL). His contribution forms the basis of all circuit analysis problems.

1) Kirchhoff's first law or Kirchhoff's Current law or **point law:**

It states as follows "In any electrical network, the algebraic sum of the current meeting at a point or junction is zero.i. e. ΣI=0. It is also called as point law.

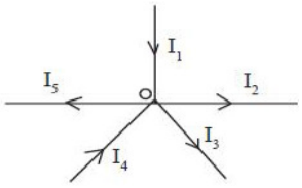


Fig.3.5: Current Law

Five conductors carrying current and meeting at a point

According to Kirchhoff's first law ΣI=0

Assuming the incoming currents to be positive and the outgoing currents to be negative.

$$I1 + I4 + (- I2) + (- I3) + (- I5) = 0$$

$$I1 + I4 = I2 + I3 + I5$$

This can also be defined as the total currents flowing towards a Junction is equal to that totalcurrents flowing away from the junction.

(2) Kirchhoff's second law or Kirchhoff's Mesh law or voltage law:

It states as follows "The algebraic sum of the products of currents and resistances in each of the conductors in any closed path (or mesh) in a network plus the algebraic sum of the e.m.f's is that path is zero" ΣIR + Σemf =0

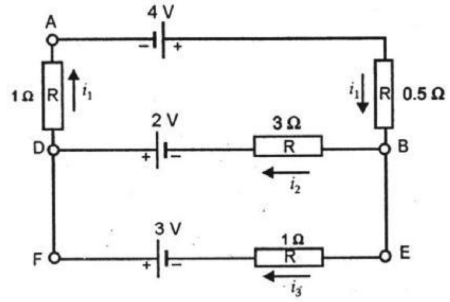


Fig.3.6: Mesh Law

WHEATSTONE BRIDGE:

Wheat stone bridge is used to measure the unknown resistance in a given network. It consistsof four arms. If the current in the galvanometer is zero it is called a balanced Circuit, then theproducts of the resistance of opposite arms are equal. Suppose the value of current through the galvanometer is not zero then the Kirchoff's laws are applied to find the currents and values of unknown resistance then it is called an 'unbalanced' bridge circuit.

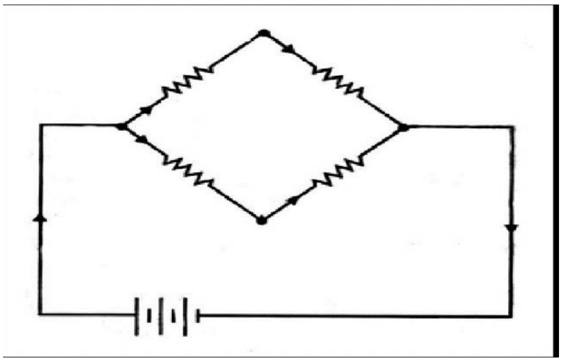


Fig.3.7: Wheatstone Bridge

INTRODUCTION TO ELECTRONICS

The branch which deals with current conduction through a Vacuum or Gas or Semiconductor is known as **Electronics.** An electronic device is that in which current flows through a vacuum or gas or semiconductor. This control of electrons is accomplished by devices that resist, carry, select, steer, switch, store, manipulate, and exploit the electron.

Or

Electronics deals with electrical circuits that involve active electrical components such as vacuum tubes, transistors, diodes and integrated circuits**,** and associated passive interconnection technologies. Commonly, electronic devices contain circuitry consisting primarily or exclusively of active semiconductors supplemented with passive elements; such a circuit is described as an electronic circuit**.**

Insulator: A material or an object that does not easily allow heat, electricity, light, or sound to pass through it. Air, cloth, wood and rubber are good electrical insulators; feathers and wool make good thermal insulators.

Conductor: A conductor is an object or type of material that allows the flow of charge (electrical current) in one or more directions. Materials made of metal are common electrical conductors.

Semiconductor: A semiconductor is a substance whose resistivity lies between the conductors and insulators. The property of resistivity is not the only one that decides a material as a semiconductor, but it has few properties as follows.

- Semiconductors have the resistivity which is less than insulators and more than conductors.
- Semiconductors have negative temperature co-efficient. The resistance in semiconductors, increases with the decrease in temperature and vice versa.
- The Conducting properties of a Semiconductor changes, when a suitable metallic impurity is added to it, which is a very important property.

Semiconductor devices are extensively used in the field of electronics. The transistor has replaced the bulky vacuum tubes, from which the size and cost of the devices got decreased and this revolution has kept on increasing its pace leading to the new inventions like integrated electronics.

ELECTRONIC COMPONENTS

a. SWITCH

Switches can come in many forms such as pushbutton, rocker, momentary and others. Their basic function is to interrupt electric current by turning a circuit on or off.

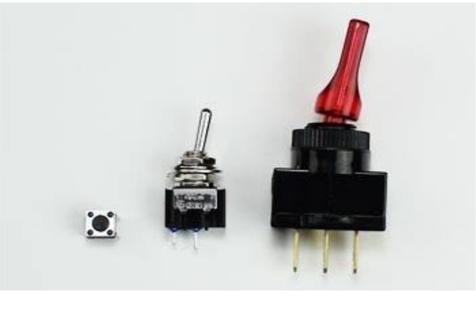


Fig.3.8: Electronic switch

b. RESISTOR

Resistors are used to resist the flow of current or to control the voltage in a circuit. The amount of resistance that a resistor offers is measured in Ohms. Most resistors have coloured stripes on the outside and this code will tell you it's value of resistance. You can use a multimeter or resistor colour code calculator to determine the value of a resistor.

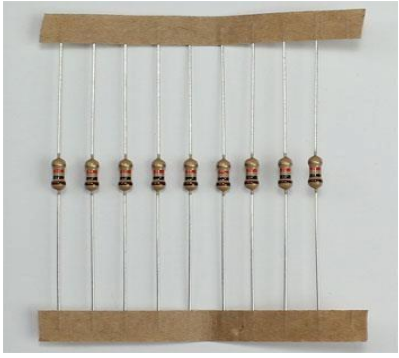


Fig.3.9: Resistor

c. VARIABLE RESISTOR (POTENTIOMETER)

A variable resistor is also known as a potentiometer. These components can be found in devices such as a light dimmer or volume control for a radio. When you turn the shaft of a potentiometer the resistance changes in the circuit.

Fig.3.10: Variable Resistor

d. LIGHT-DEPENDENT RESISTOR (LDR)

A light-dependent resistor is also a variable resistor but is controlled by the light versus turning a knob. The resistance in the circuit changes with the intensity of the light. These are often found in exterior lights that automatically turn on at dusk and off at dawn.

Fig.3.11: Light-dependent Resistor

e. CAPACITOR

Capacitors store electricity and then discharges it back into the circuit when there is a drop in voltage. A capacitor is like a rechargeable battery and can be charged and then discharged. The value is measured in F (Farad), nano Farad (nF) or pico Farad (pF) range.

Fig.3.12: Capacitor

f. DIODE

A diode allows electricity to flow in one direction and blocks it from flowing the opposite way. The diode’s primary role is to route electricity from taking an unwanted path within the circuit.

Fig.3.13: Diode

g. LIGHT-EMITTING DIODE (LED)

A light-emitting diode is like a standard diode in the fact that electrical current only flows in one direction. The main difference is an LED will emit light when electricity flows through it. Inside an LED there is an anode and cathode. Current always flows from the anode (+) to the cathode (-) and never in the opposite direction. The longer leg of the LED is the positive (anode) side.

Fig.3.14: Light-Emitting Diode

h. TRANSISTOR

Transistor are tiny switches that turn a current on or off when triggered by an electric signal. In addition to being a switch, it can also be used to amplify electronic signals. A transistor is similar to a relay except with no moving parts.

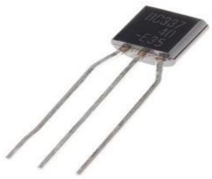


Fig.3.15: Transistor

i. RELAY

A relay is an electrically operated switch that opens or closes when power is applied. Inside a relay is an electromagnet which controls a mechanical switch.

Fig.3.16: Relay

j. INTEGRATED CIRCUIT (IC)

An integrated circuit is a circuit that’s been reduced in size to fit inside a tiny chip. This circuit contains electronic components like resistors and capacitors but on a much smaller scale. Integrated circuits come in different variations such as 555 timers, voltage regulators, microcontrollers and many more. Each pin on an IC is unique in terms of it’s function.

Fig.3.17: Integrated Circuit

k. VACUUM TUBE

The **vacuum tube** is a glass tube that has its gas removed, creating a vacuum. Vacuum tubes contain electrodes for controlling electron flow and were used in early computers as a switch or an amplifier. The picture shows a collection of different vacuum tubes used with different devices. Vacuum tubes were also used in radios, televisions, radar equipment, and telephone systems during the first half of the 1900s. In the 1950s, the transistor started to replace the vacuum tube.

Fig.3.18: Vacuum Tubes

P-N JUNCTION DIODE

P-N Junction diode is a piece of silicon that has two terminals. One of the terminals is doped with P-type material (Boron) and the other with N-type material (phosphorous). The P-N junction diode is the basic element for semiconductor diodes. A semiconductor diode facilitates the flow of electrons completely in one direction only, which is the main function of semiconductor diode. It can also be used as a rectifier.

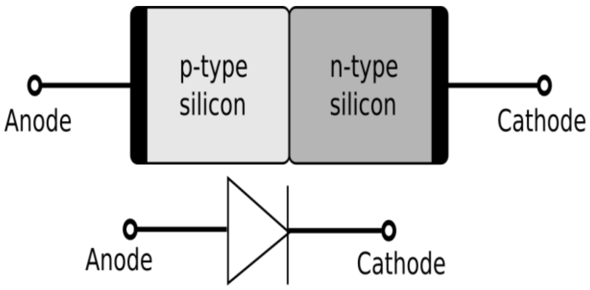


Fig.3.19: P-N Junction Diode

There are two operating regions: P-type and N-type. Based on the applied voltage, there are three possible “biasing” conditions for the P-N junction diode, which are as follows:

Zero Bias: No external voltage is applied to the P-N junction diode.

Forward Bias: The voltage potential is connected positively to the P-type terminal and negatively to the N-type terminal of the diode.

Reverse Bias: The voltage potential is connected negatively to the P-type terminal and positively to the N-type terminal of the diode.

N-P-N & P-N-P TRANSISTOR

In an NPN transistor, a positive voltage is given to the collector terminal to produce a current flow from the collector to the emitter.

In an PNP transistor, a positive voltage is given to the emitter terminal to produce current flow from the emitter to the collector.

NPN and PNP transistors are bipolar junction transistors and they are basic electrical and electronic components. The PNP and NPN transistors allow current amplification. These transistors are used as switches, amplifiers or oscillators. In PNP transistors, majority charge carriers are holes, where as in NPN transistors, electrons are the majority charge carriers.

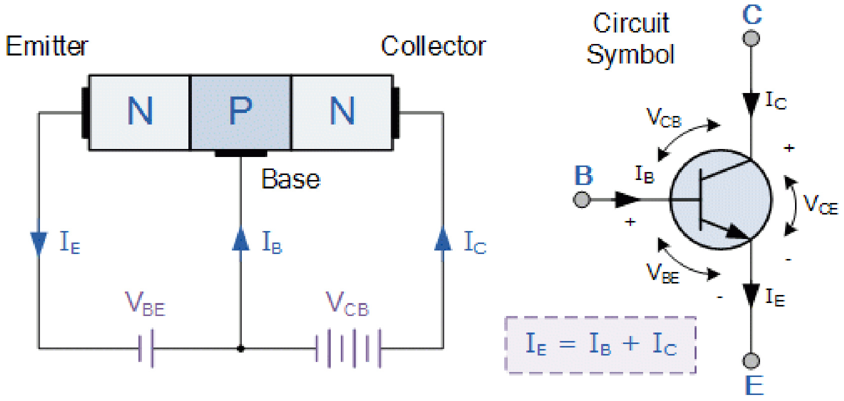


Fig.3.20: N-P-N Transistor

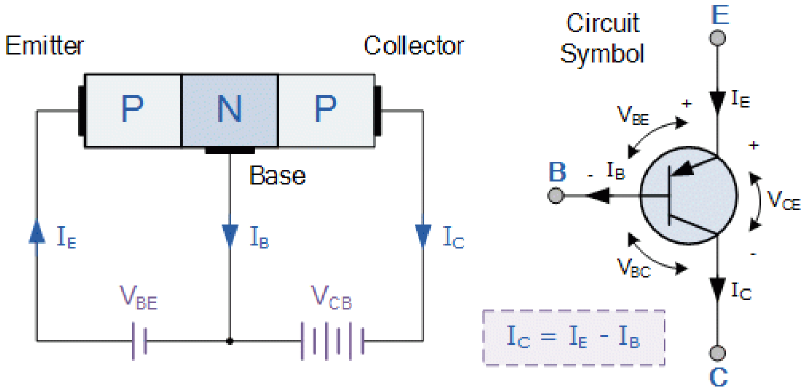


Fig.3.21: P-N-P Transistor

INTEGRATED CIRCUIT AND TYPES

An integrated circuit or monolithic integrated circuit is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material that is normally silicon.

Advantages:

1. Low cost and high performance
2. Less material
3. Low power consumption

Disadvantages:

1. High cost

IC'S CLASSIFICATION

1. Analog
2. Digital
3. Mixed signal
4. Three-dimensional IC's

Analog IC's are sub-categorized as:

a) Linear Integrated circuits b) R.F (Radio Frequency) circuits

Digital IC's are sub-categorized as:

a) Logic IC's b) Memory chips c) Interface IC's d) Power management IC's

e) Programmable devices

Mixed IC's are sub-categorized as:

a) Data acquisition IC's (Including A/D convertors, D/A convertors, Digital potentiometers)

b) Clock/Timing IC's c) Switched capacitor circuits d) R.F COMOS circuits

Three-dimensional IC's are sub-categorized as:

a) Through-silicon via (TSV) b) Cu-Cu connection IC's

BINARY SYSTEM

Computers use voltages and since voltages changes often, no specific voltage is set for each number in the decimal system. For this reason, binary is measured as a two-state system i.e ON or OFF.

VOLTAGE LEVELS

Acceptable input signal voltages range from 0 volts to 0.8 volts for a "low" logic state and 2 volts to 5 volts for a "high" logic state. If a voltage signal ranging between 0.8 volts to 2 volts were to be sent in to the input of a TTL gate, there would be no certain response from the gate.

MICROPROCESSOR 8085

It is pronounced as eighty-eighty five microprocessor. It is 8-bit microprocessor. It is used in washing machines, microwave ovens, mobile phones etc. 8085 microprocessors mainly includes the timings control unit, arithmetic and logic unit, decoder, instruction register, Interrupt control, a register array, serial input/output control. The most important part of the microprocessor is the central processing unit.

MICROCONTROLLER 8051

It is a 8-bit micro controller. It is built with 40 pins o/p (dual inline package) 4 kb of ROM storage, 128 bytes of RAM storage and two 16-bit timers. It consists of four parallel 8-bit ports which are programmable as well as addressable as per the requirement. As on-chip crystal oscillator is integrated in the microcontroller having crystal frequency of 12 MHz.

ELECTRONIC NAVIGATION SYSTEM IN AUTOMOBILE

An automobile navigation system is part of the automobile controls add-on used to find direction in an automobile. It typically uses a satellite navigation device to get its position data which is then correlated to a position on a road. When directions are needed routing can be calculated. On the fly traffic information can be used to adjust the route.

Dead reckoning using distance data from sensors attached to the drive train. A gyroscope and a accelerometer can be used for greater reliability as GPS signal loss and or multipath can occur due to urban canyons or tunnels.

Mathematically, automotive navigation is based on the shortest path problem within graph theory which examines how to identify the path that best meets some criteria (shortest, cheapest, fastest etc.) between two points in a large network.

Automotive navigation system are crucial for the development of self-driving cars.

Short Answer Questions

1. Define electrical potential and give its units.
2. Explain resistance.
3. Define current.
4. Explain Ohm's law.
5. Write laws of resistance.
6. Explain Kirchhoff's law.
7. Explain forward bias and reverse bias.
8. Write the purpose of navigation system in vehicles.

Long Answer Questions

1. Explain basic circuit components i) Resistor ii) Inductor iii) Capacitor.
2. a) Derive the total resistance $R= R_1 + R_2 + R_3 + \dots$ in series connection of resistance.

   b) Derive the resistance $1/R = 1/R_1 + 1/R_2 + 1/R_3 + \dots$ in parallel connection of resistance.
3. Explain the components used in electronic system.
4. Explain integrated circuit and write the classification.