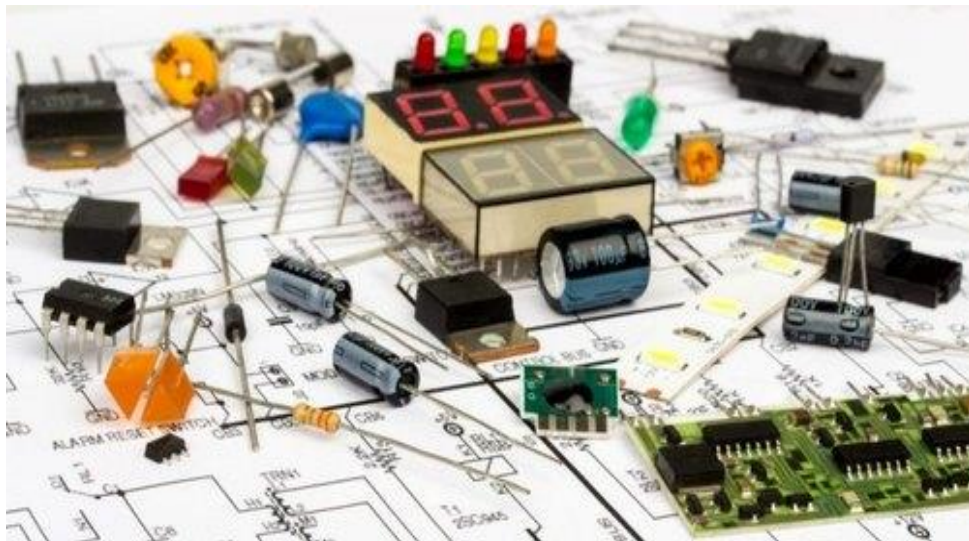




BHADRAK ENGINEERING SCHOOL & TECHNOLOGY (BEST),  
ASURALI, BHADRAK

# Basic Electronic Engineering (Th: 04-b)

(As per the 2018-19 syllabus prepared by the  
SCTE&VT, Bhubaneswar, Odisha)



First Semester

Common to all Engg. Courses

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# **BASIC ELECTRONIC ENGINEERING**

## **CHAPTER-WISE DISTRIBUTION OF PERIODS & MARKS**

Sl. No.	Chapter No.	Topics	Periods as per syllabus	Periods actually needed	Expected marks
01	01	Electronic Devices	08	07	08
02	02	Electronic Circuits	09	10	12
03	03	Communication System	03	04	10
04	04	Transducers And Measuring Instruments	10	10	18
Total			30	31	48

# CHAPTER-1

## ELECTRONIC DEVICE

### **LEARNING OBJECTIVES:**

- 1.1 Basic Concept of Electronics and its application.*
- 1.2 Basic Concept of Electron Emission & its types.*
- 1.3 Classification of material according to electrical conductivity (Conductor, Semiconductor & Insulator) with respect to energy band diagram only.*
- 1.4 Difference between Intrinsic & Extrinsic Semiconductor.*
- 1.5 Difference between vacuum tube & semiconductor.*
- 1.6 Principle of working and use of PN junction diode, Zener diode and Light Emitting Diode (LED)*
- 1.7 Integrated circuits (I.C) & its advantages.*

### **1.1 BASIC CONCEPT OF ELECTRONICS AND ITS APPLICATION: ELECTRONICS-**

The branch of engineering 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.

(Or)

Electronics is the branch of science that deals with the study of the flow of electrons and their effects in a vacuum, gases, and semiconductor materials.

#### **Application of electronics: -**

- Consumer Electronics.
- Commercial applications.
- Medical applications.
- Agriculture application
- Industrial automation
- Communication
- Military & defense applications
- Automobiles
- Aerospace

#### **Fundamentals of electronics: -**

#### **Valence cell: -**

- The outer most cell of an atom is known as valence cell.

#### **Electron: -**

- It is one of the most fundamental particles of an atom having a -ve charge.

#### **Valence Electron**

- The electron present in the outer most orbit is known as valence electron.

#### **Free electron: -**

- The valence electron which are loosely attracted by the nucleus is called as free electron.
- The free electrons are responsible for current conduction.

## 1.2 BASIC CONCEPT OF ELECTRON EMISSION & ITS TYPES:

Electron emission is defined as the liberation of electrons from any surface of a substance.

### Work function: -

The amount of additional energy required to emit an electron from a metallic surface is known as work function of that metal.

### Types of electronic emission: -

→ There are 4 types of electron emission

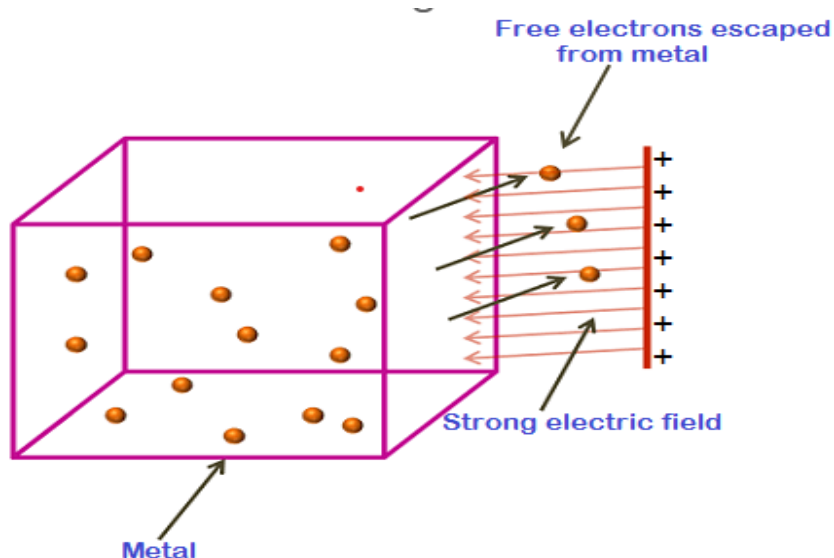
1. Thermionic emission
2. Field emission
3. Photo electric emission
4. Secondary emission

### 1. Thermionic emission: -

- The process of electron emission from a metal surface by supplying thermal energy to it is known as thermionic emission.
- In this method, the metal is heated to sufficient temperature (about  $2500^{\circ}\text{C}$ ) to enable the free electrons to leave the metal surface. The number of electrons emitted depends upon the temperature. The higher the temperature, the greater is the emission of electrons. This type of emission is employed in vacuum tubes.

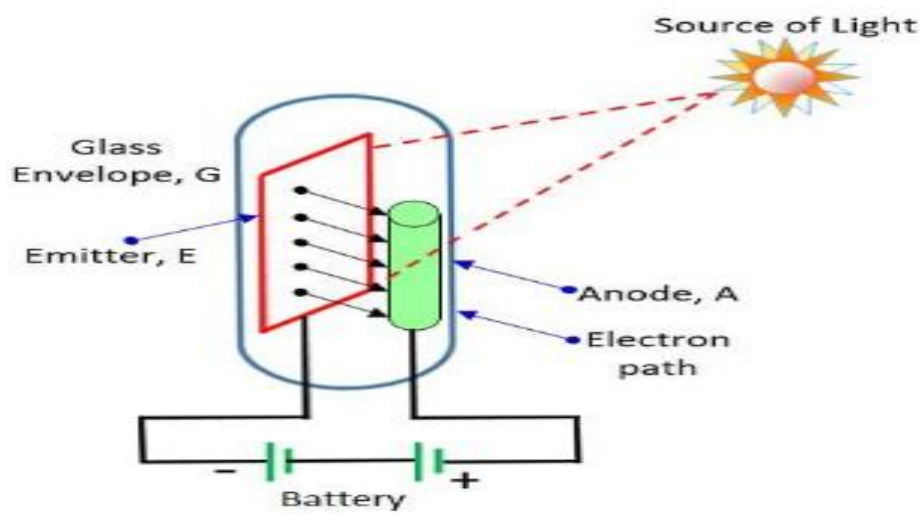
### 2. Field emission: -

- The process of electron emission by the application of strong electric field at the surface of a metal is known as field emission.
- In this method, when a sufficiently high positive charge is placed in front of the emitter surface, due to the strong electrostatic force of the created electric field, the free electron can get sufficient energy to overcome the surface barrier and can get emitted from the surface of the emitter body. As this type of electron emission is caused by the electric field present in the space, it is called field emission. The stronger the electric field, the greater is the electron emission.



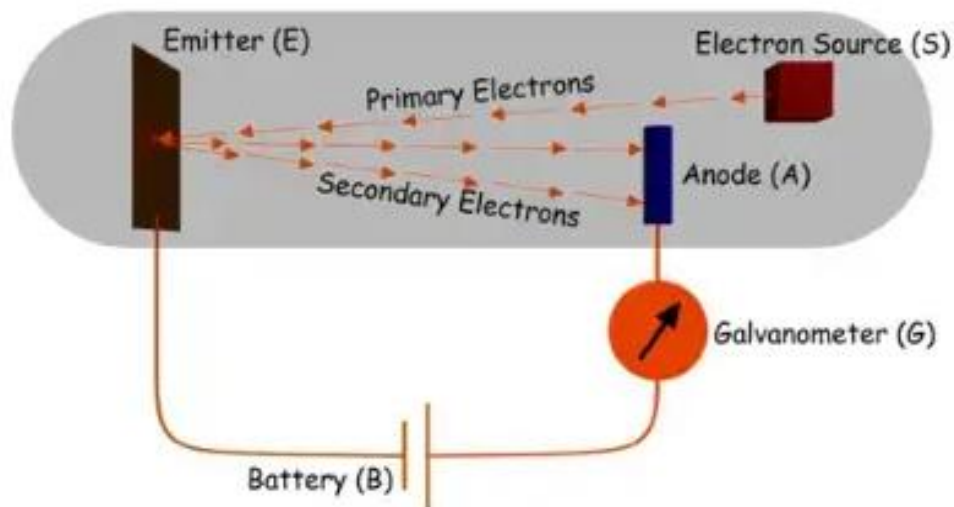
### 3. Photo electric emission: -

- Electron emission from a metallic surface by the application of light is known as photo electric emission.
- In this method, the energy of light falling upon the metal surface is transferred to the free electrons within the metal to enable them to leave the surface. The greater the intensity (i.e. brightness) of light beam falling on the metal surface, the greater is the photo-electric emission.



#### **4.Secondary emission: -**

- Electron emission from a metallic surface by the bombardment of high-speed electrons or other particles is known as secondary emission.
- In this method, When a beam of high-velocity electrons strikes on the metal surface, the kinetic energy of high velocity striking electrons, transferred to the free electrons on the metal surface. Thus the free electrons may get sufficient kinetic energy to overcome the surface barrier and knocked out from the surface & start electron emission. This type of emission is known as secondary electron emission. The electrons that strike the metal are called primary electrons while the emitted electrons are known as secondary electrons.



#### **Energy band: -**

- The range of energy occupied by an electron is known as energy band.

### **Valence band: -**

→ The range of energy occupied by valence electron is known as valence band.

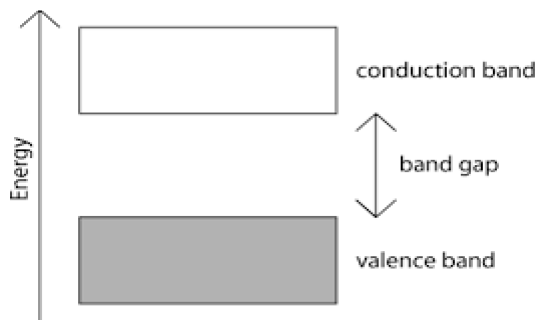
### **Conduction band: -**

→ The range of energy occupied by conduction electron is known as conduction band.

### **Forbidden energy gap: -**

→ The gap between valence band and conduction band in the energy band diagram is known as forbidden energy gap.

→ Its unit is eV (Electron Volt)

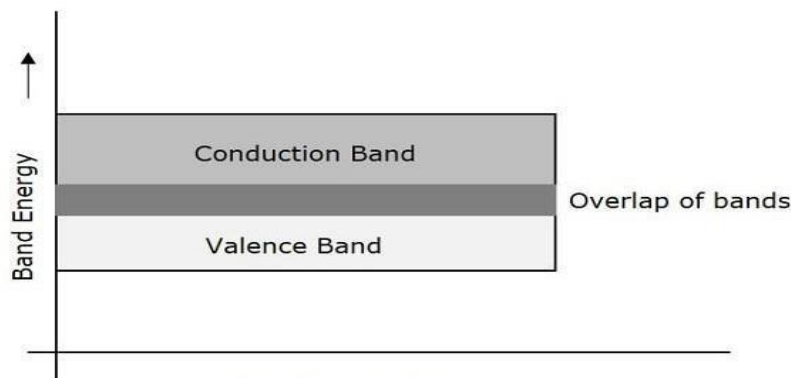


## **1.3 CLASSIFICATION OF MATERIAL ACCORDING TO ELECTRICAL CONDUCTIVITY (CONDUCTOR, SEMICONDUCTOR & INSULATOR) WITH RESPECT TO ENERGY BAND DIAGRAM ONLY:**

- According to electrical conductivity solid can be classified in 3 types.
  1. Conductor
  2. Insulator
  3. Semi-conductor

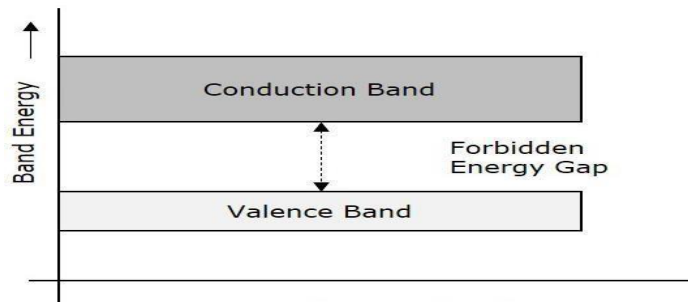
### **1. Conductor: -**

- The materials through which electricity can be passed easily are known as conductor.
- The conduction band and valence band overlap with each other.
- Ex-Iron, Gold, Copper etc.
- The energy band diagram can be shown as below.



### **2. Insulator: -**

- The materials through which no electricity can pass are known as insulators.
- The forbidden energy gap is nearly equal to 15 eV.
- Ex-Wood, Rubber, Glass etc.
- The energy band diagram can be shown as below.



### **3.Semi-conductor: -**

- The materials whose electrical conductivity lies in between conductor and insulator are known as semiconductors.
- The forbidden energy gap (fg) in case of semiconductor is 1.1 eV.
- In terms of energy band, the valence band is almost filled and conduction band is almost empty.
- Therefore, comparatively smaller electric field (smaller than insulators but much greater than conductors) is required to push the electrons from the valence band to the conduction band.
- The energy band diagram can be shown as below.



#### **Doping: -**

- The process of adding impurity in pure form of semiconductor is known as doping. Impurity itself is called as dopant.
- According to electrical conductivity, semiconductor can be classified in 2 types, such as Intrinsic semiconductor & extrinsic semiconductor.

## **1.4 DIFFERENCE BETWEEN INTRINSIC SEMICONDUCTOR & EXTRINSIC SEMICONDUCTOR:**

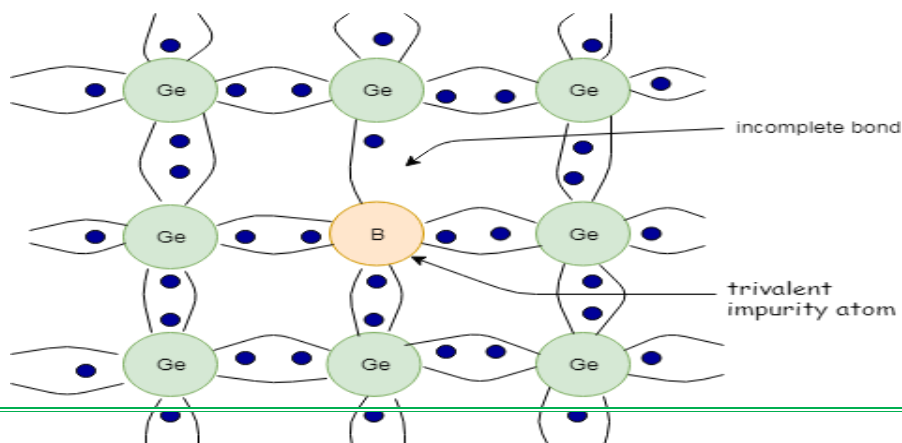
PARAMETERS	INTRINSIC SEMICONDUCTOR	EXTRINSIC SEMICONDUCTOR
Definition	The semiconductor in its pure form is known as intrinsic semiconductor.	When a chemical impurity is added to an intrinsic semiconductor, then the resulting semiconductor is known as extrinsic semiconductor.
Types	There is no classification of intrinsic semiconductor.	Based on the impurity added, the extrinsic semiconductors are of two types viz. P-type semiconductor and N-type semiconductor.
Doping	In case of intrinsic semiconductor, there is no doping or addition of impurity.	In an extrinsic semiconductor, the doping is performed, i.e. a small amount of impurity is added in the pure semiconductor.
Conductivity	The electrical conductivity of intrinsic semiconductors is low.	The extrinsic semiconductors have high electrical conductivity.
Operating temperature	Intrinsic semiconductors have low operating temperature.	The operating temperature for extrinsic semiconductors is high.
Charge carrier density	In an intrinsic semiconductor, the number of electrons is equal to the number of holes.	In case of extrinsic semiconductors, the number of holes and electrons are not equal. In a P-type semiconductor, the holes are more than electrons, while in an N-type semiconductor, the electrons are more than holes.
Examples	The crystalline forms of pure silicon and germanium are the examples of intrinsic semiconductors.	The examples of extrinsic semiconductors are pure silicon and germanium doped with chemical impurities like As, P, Bi, Sb, In, B, Al, etc.

Extrinsic semiconductor is again classified into 2 types.

1. P- type semiconductor
2. N- type semiconductor

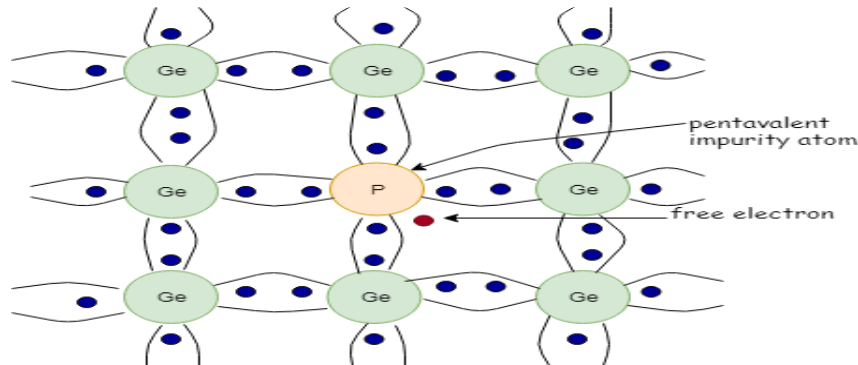
### **1. P type semiconductor: -**

When a small amount of trivalent impurity is added to a pure semiconductor, it is called p-type Semiconductor. The addition of trivalent impurity provides a large number of holes in the semiconductor. Typical examples of trivalent impurities are gallium, indium, boron etc. Such impurities which produce p-type semiconductor are known as acceptor impurities because the holes created can accept the electrons. In p-type semiconductor holes are the majority carriers whereas electrons are said to be the minority carriers.



## **2. N type semiconductor: -**

When a small amount of pentavalent impurity is added to a pure semiconductor, it is known as n-type semiconductor. The addition of pentavalent impurity provides a large number of free electrons in the semiconductor crystal. Typical examples of pentavalent impurities are arsenic, antimony, Bismuth and Phosphorous etc. Such impurities which produce n-type semiconductor are known as donor impurities because they donate or provide free electrons to the semiconductor crystal. In n-type semiconductor electrons are said to be the majority carriers whereas holes are the minority carriers.



## **1.5 DIFFERENCE BETWEEN VACUUM TUBE AND SEMICONDUCTOR:**

### **Vacuum Tube**

- Large in size.
- Cost is high.
- More heat generation.
- Low efficiency.
- Less sensitive to temperature.
- High input impedance.
- Low voltage gain

### **Semiconductor**

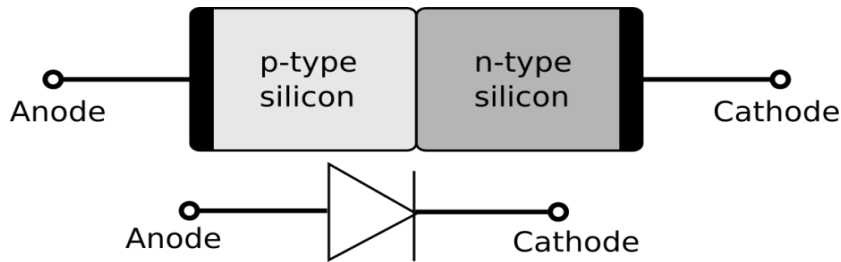
- Smaller in size.
- Cost is low.
- Less heat generation.
- High efficiency.
- High sensitive to temperature.
- Low input impedance.
- High voltage gain

## **1.6 WORKING PRINCIPLE OF P N JUNCTION DIODE, ZENER DIODE & LED:**

### **P N Junction: -**

- When P type semiconductor is suitably joined with a N type semiconductor, then the contact surface is known as P N junction.
- One P N junction is known as semiconductor diode. It has two terminals, one is +ve other one is -ve.

- **SYMBOL: -**



**Depletion layer: -**

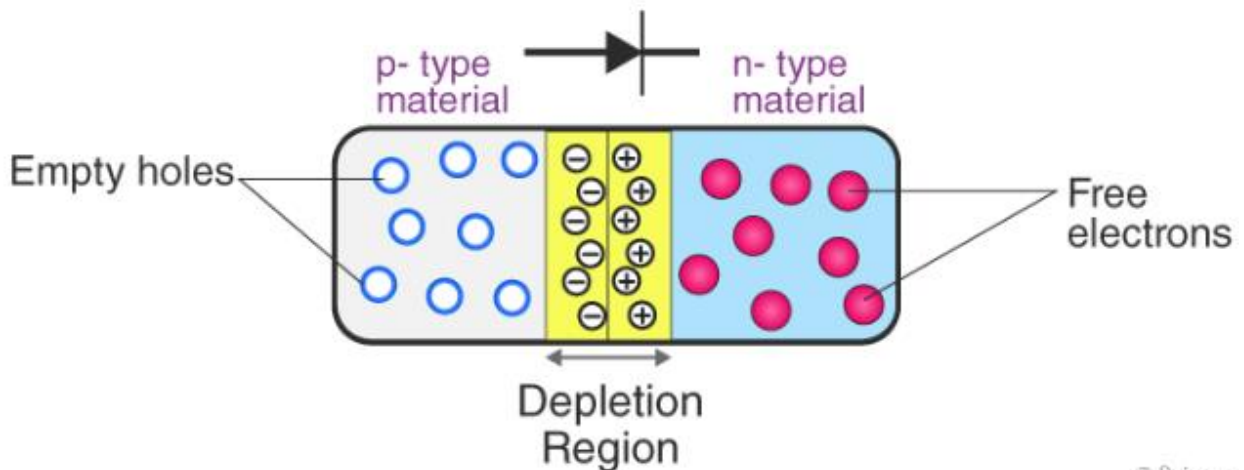
Due to this charge separation a layer of negative charges (trivalent ions) in p-type & positive charges (pentavalent ions) in n-type near the junction created. These two layers of positive and negative charges form the depletion region(or depletion layer).

**Potential barrier: -**

The holes in p-side encounters a positive charge in n-side near the junction similarly electrons in n-side encounters a negative charge in p-side near the junction. The positive and negative charges set up an electric field. The electric field is a barrier to the free electrons in the n-region. There exists a potential difference across the depletion layer and is called barrier potential.

**Pn- junction Diode:**

A pn junction is known as a semi-conductor or crystal diode. It is a two terminal unidirectional (allows current only in single direction) semiconductor device. The lead connected to p-side called anode and the lead connected to n-side called cathode of the diode. The circuit symbol of diode is shown in figure.



This pn junction does not allow flow of current. To make it suitable for electronics circuits we need to biasing (applying external voltage) pn-diode. There are two ways of biasing pn-diode

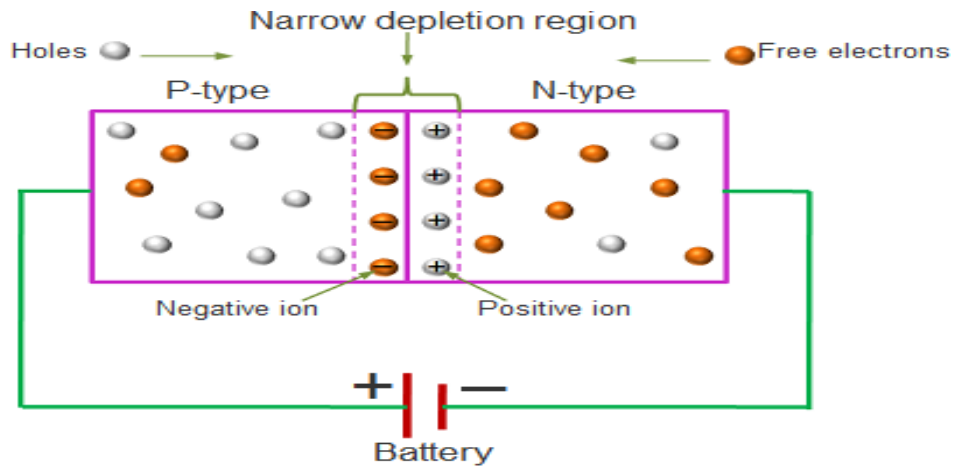
- (i) Forward biasing
- (ii) Reverse biasing

**Forward biasing: -**

- When P type semiconductor is connected to the +ve terminals of the battery & N type semiconductor is connected to the -ve terminal of the battery then this is known as forward biasing.
- In case of forward biasing, since the voltage source is connected in the forward direction. So, the +ve terminal of the battery will repel the holes present in the P type materials.
- Similarly, the -ve terminal of the battery will repel the electrons present in the N type

materials.

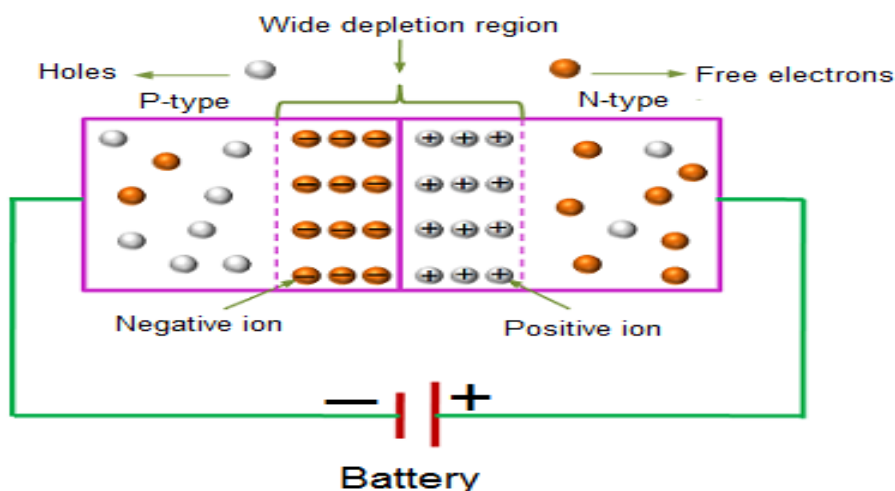
- As a result of which the electrons will start moving in a path as shown in figure.
- In forward biasing case the resistance is very low.
- Since the depletion layer is negligible. So, the current conduction occurs in case of forward biasing.



- The forward voltage at which the depletion region vanishes and the current in diode raises rapidly is called Knee voltage.

#### **Reverse biasing: -**

- When a P type semiconductor is connected to the -ve terminal of the battery & N type semiconductor is connected to the +ve terminal of the battery then it is known as reverse biasing.
- Before the connection of voltage source there is a depletion layer which is marked as the original depletion layer.
- When the voltage source is connected in reverse biasing mode, then the depletion layer increases. So, the barrier potential also increases.
- Due to the large barrier potential, no current flows across the junction. So, in reverse biasing no current flows.

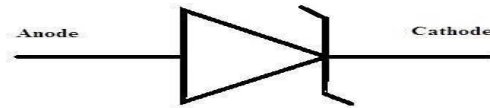


#### **Conclusion: -**

- From the above discussion we can conclude that current flows through a diode in forward biasing and in case of reverse biasing no current flows through a diode.

### **ZENER DIODE: -**

Zener diode is an ordinary diode which is properly doped so that it has a sharp breakdown voltage. Unlike normal pn junction diode it allows current in forward bias as well as reverse bias condition. It starts conducting in reverse direction when reverse voltage reaches a predetermined value. Zener diode is mostly used in reverse bias condition only. The circuit symbol is shown in figure.



### **Working principle:**

When zener diode connected in the reverse mode, which is usual in most of its applications, a small leakage current may flow. As the reverse voltage increases to the predetermined breakdown voltage ( $V_z$ ), a current starts flowing through the diode. The current increases to a maximum, which is determined by the series resistor, after which it stabilizes and remains constant over a wide range of applied voltage.

### **APPLICATION OF ZENER DIODE: -**

- Zener diodes are used as voltage regulator.

### **LIGHT EMITTING DIODE(LED): -**

- LED is a special type of PN junction diode which gives off visible light when forward biased.

### **SYMBOL: -**



### **OPERATION OF LED: -**

When light-emitting diode (LED) is forward biased the electrons from the n-type material cross the pn junction and recombine with holes in the p-type material. These free electrons are in the conduction band and at a higher energy level than the holes in the valence band. When recombination takes place, the recombining electrons release some part of energy in the form of heat and light. In Si & Ge diodes these energy dissipate in the form of heat but in Gallium-Arsenide-phosphorous (GaAsP) and Gallium-phosphorous (GaP) semiconductors, the electrons dissipate energy in the form of photons. Light Emitting Diodes are made from exotic semiconductor compounds such as Gallium, Arsenide, Phosphorus all mixed together at different ratios to produce a distinct wavelength of colour.

### **APPLICATION OF LED: -**

- As a power indicator.
- 7 segments display etc.

## **1.7 INTEGRATED CIRCUITS (IC) & ITS ADVANTAGES:**

An integrated circuit sometimes called Chip or Microchip is one in which thousand no of circuit components like transistors, diodes, resistors, capacitors etc. are fabricated on a small semiconductor chip.

It consists of a number of circuit components (e.g. transistors, diodes, resistors etc.) and their inter connections in a single small package to perform a complete electronic function and the individual components cannot be removed or replaced.

The size of this is so small that we need microscope to see the inter connections.

### **Advantages of IC**

Integrated Circuits has many advantages over discrete circuits such as:

Extremely small in size,

Low power consumption,

Reliability,

Reduced cost,

Very small weight

Easy replacement.

### **Disadvantages of IC: -**

Cannot produce high power.

Transformer & inductor cannot be fabricated.

If any one of circuit component fails, then the whole IC will be replaced.

### **USES: -**

Voltage regulator.

IC 555 as multivibrator.

Constant current source.

## **POSSIBLE SHORT TYPE QUESTION WITH ANSWER**

### **1. Define electronics. [W-16,17,18; S-17]**

Ans: -It is the branch of engineering which deals with the current conduction through the vacuum tube, semiconductor or gas.

### **2. Define doping.**

Ans: -The process of adding impurities to the pure form of semiconductor is known as doping.

➤ The impurity itself is called dopant.

### **3. What is a semiconductor? [**

Ans: -The material whose electrical conductivity lies in between conductor and insulator are known as semiconductor.

Ex-Ge, Si

### **4. Define electron emission. [W-18,20; S-19, W-22]**

Ans: The liberation of electron from the surface of a metal is known as electron emission.

### **5. Write different types of electronic emission. [W-18,20; S-19]**

Ans: - a) Thermionic emission.

b) Field emission.

c) Photo electric emission.

d) Secondary emission.

### 6. Define I C. [W-17]

Ans: -An I C is a circuit in which the circuit compounds such as transistor, diode, capacitor, resistor etc are automatically part of small semiconductor chip.

### 7. What is LED and give its two application?

Ans: -LED is a special type of PN junction diode which gives of visible light when forward biased.

- Its two applications are
- As a power indicator
  - 7 segments display etc.

### 8. Write two difference between intrinsic and extrinsic semiconductor.[W-22]

Intrinsic Semiconductors	Extrinsic Semiconductors
1.Semiconductor in its purest form.	1.Semiconductor in its impure form.
2.It has low conductivity.	2.It has a higher conductivity than an intrinsic semiconductor.

## POSSIBLE LONG TYPE QUESTION

- Define Emission and explain various types of emission in details. [W-17,18,20; S-19]
- Difference between semiconductor and vacuum tube.[W-18, S-18, 19,W-22]
- Classify solids according two energy band diagrams. [W-17, 18,19; S-19]
- Write short note on I C?
- Explain working principle of P N junction diode.
- Write short notes on
  - LED
  - Zener Diode[W-22]



## CHAPTER NO. - 02

### ELECTRONICS CIRCUIT

#### LEARNING OBJECTIVES

2.1 –Define Rectifier & It's Uses.

2.2 Principles Of Working Of Different Types Of Rectifier & Their Merit & Demerit.

2.3- Function Of Filters & Classification simple Filter Characteristics (capacitor, choke & pie).

2.4 Dc Power Supply System with Help Of Block Diagram Only

2.5 Different Types Transistor Configuration & State Output & Input Current Gain relationship in CE, CB & CC configuration (no mathematical derivation).

2.6-Need of Biasing & Different Types Of Biasing With Circuit Diagram (CE - Configuration).

2.7 Amplifiers concept, working principle of single Phase Rc Coupled Amplifier.

2.8 –Electronics Oscillator & It's Classification.

2.9 – Working of basic oscillator with different elements through simple block diagram.

#### **2.1 DEFINE RECTIFIER & IT'S USES**

- Rectifier is an electronics device which convert alternating current to direct current.

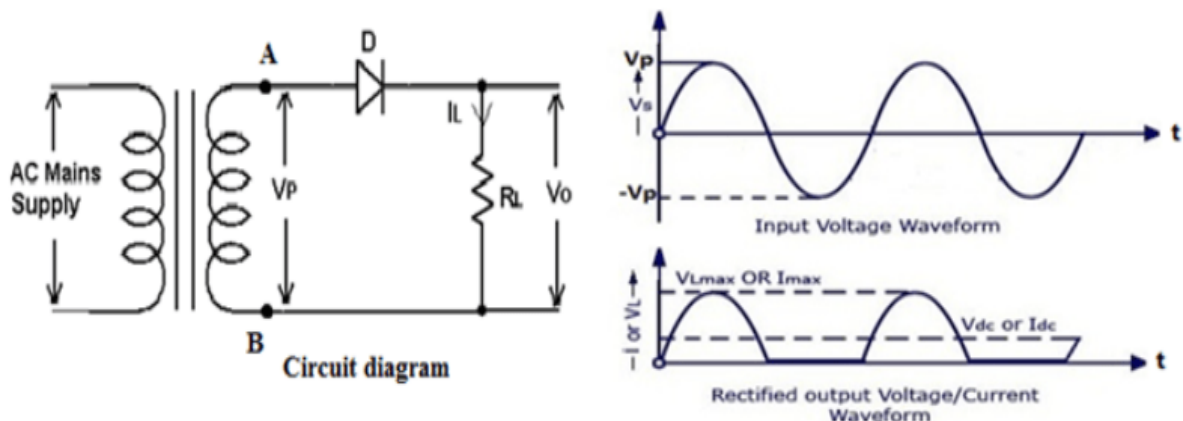
##### **Uses of rectifier-**

- It is used in house hold accessories like laptop, radio ,tv, videogame

#### **2.2 PRINCIPLES OF WORKING OF DIFFERENT TYPES OF RECTIFIERS WITH THEIR MERITS & DEMERITS:**

- It divided into two types
  - Half wave rectifier
  - Full wave rectifier

##### **Half wave rectifier-**



## Working principle:

- During +ve half cycle of i/p AC voltage, end A becomes +ve w.r.t to end B
- Under this condition the diode D is forward biased & hence it conducts current
- During -ve half cycle of i/p AC voltage, end B becomes +ve w.r.t to end A
- Under this condition the diode D is reverse biased & hence it does not conduct
- Therefore, current flows through the diode during +ve half cycle & is blocked in -ve half cycle.

## Advantage of half wave rectifier-

- It is a simple circuit
- It has low cost & we can easily construct
- It has less no. of components so it is very cheap

## Disadvantage of half wave rectifier-

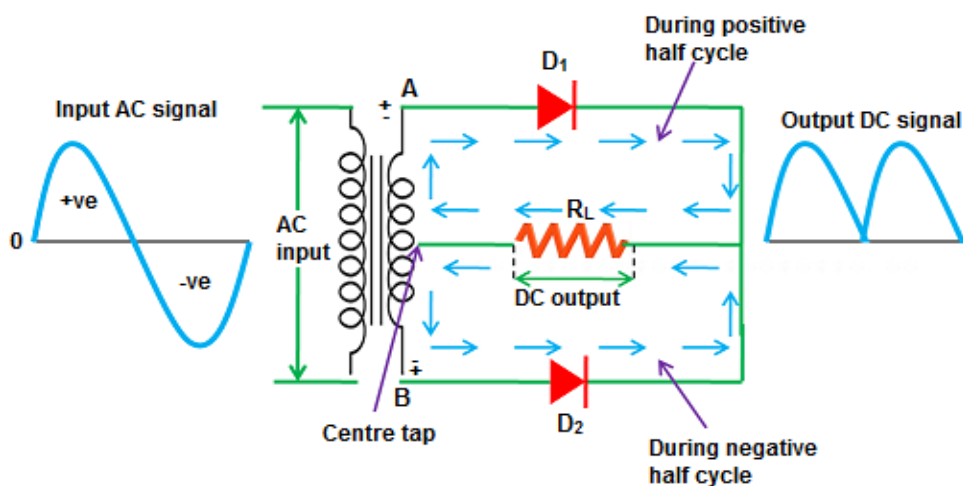
- Output is not purely DC, it has high ripple factor.
- It produces low output voltage.

## Full wave rectifier-

- It is of two types .
  - Center tap full-wave rectifier
  - Bridge type full-wave rectifier

## Center tap full-wave rectifier-

### Circuit Diagram:



## Working principle-

- It contains two diodes
- During +half cycle terminal A is +ve & terminal B is -ve .i.e. diode  $D_1$  is forward biased & it conducts current but  $D_2$  is reverse biased so it does not conduct current.
- During -half cycle terminal A is -ve & terminal B is +ve .i.e. diode  $D_1$  is reverse biased & it does not conduct current but  $D_2$  is forward biased so it conducts current.

- In this way we get the output in both the half cycle.

### Advantage of center tape full wave rectifier-

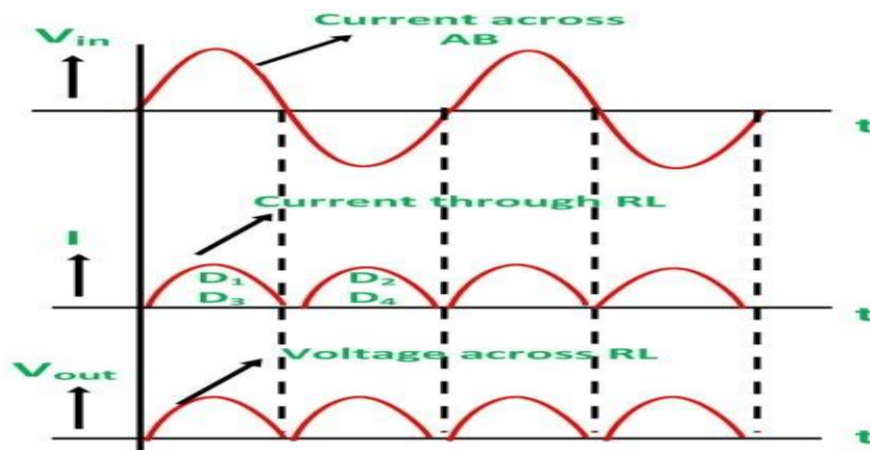
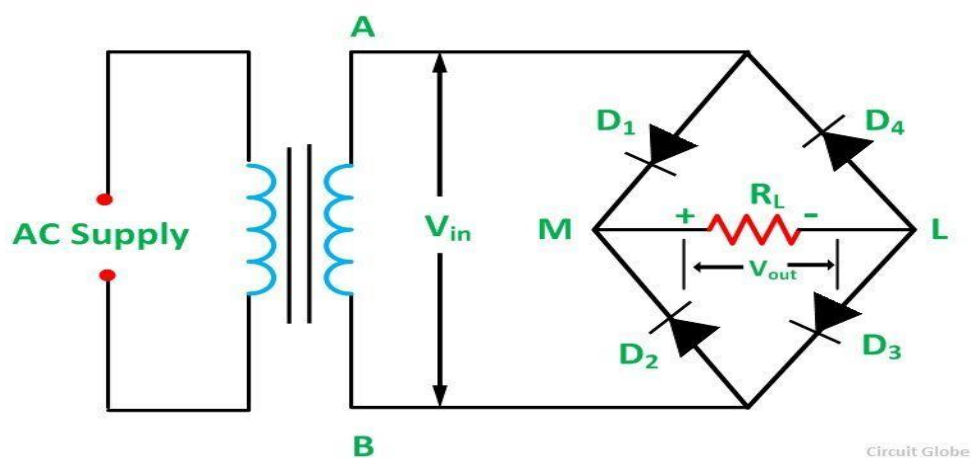
- It has efficiency twice of half wave rectifier
- Low ripples in output dc signal
- Low power loss

### Disadvantage of center tape full wave rectifier

- The output voltage is half of the secondary voltage, as each diode utilizes only one half of the transformer secondary voltage.

### Bridge rectifier-

#### Circuit diagram-



### Working principle-

- It contains four diodes.
- During +ve half cycle of secondary winding voltage the terminal A of the secondary winding becomes +ve & B becomes -ve.
- So, the diode  $D_1$  &  $D_3$  forward biased while  $D_2$  &  $D_4$  reverse biased, so  $D_1$  &  $D_3$  are conduct current but  $D_2$  &  $D_4$  does not conduct current.
- During -ve half cycle of secondary winding voltage the terminal A of the secondary winding becomes -ve & B becomes +ve.

- So, the diode  $D_1$  &  $D_3$  reverse biased while  $D_2$  &  $D_4$  forward biased, So  $D_1$  &  $D_3$  are not conduct current but  $D_2$  &  $D_4$  conduct current.
- In this way we get the output in both the half cycle.

### Advantage of bridge full wave rectifier-

- High rectifier efficiency.
- Low power loss as compared to half wave rectifier.

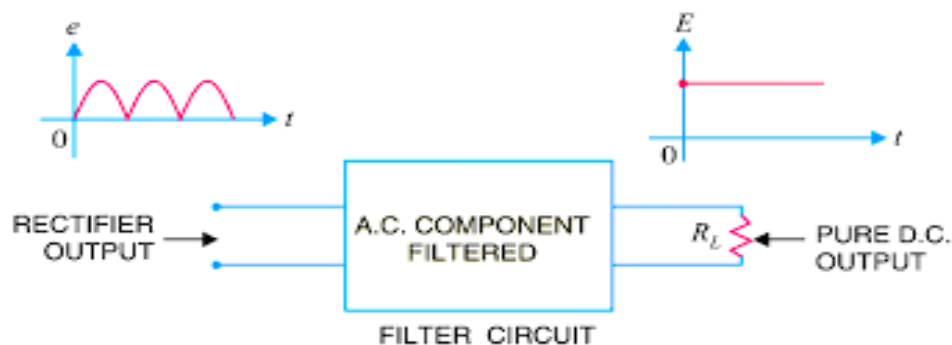
### Disadvantage of bridge full wave rectifier

- Since four diodes are used, cost is high.
- The output is not a proper DC quantity. It has ripples in its output.
- More power loss compared to center tapped full wave rectifier.

## 2.3- FUNCTION OF FILTERS AND CLASSIFICATION OF SIMPLE FILTER CIRCUIT (CAPACITOR, CHOKE INPUT AND PIE):

### Filter Circuit-

- A filter is a device which removes the AC component of rectifier output & allow the pure DC to the load resistor.
- This circuit generally combination of capacitor & inductor.



### Types of Filter Circuit:

- (1) Capacitor filter
- (2) Choke filter
- (3) Pie  $\pi$  filter

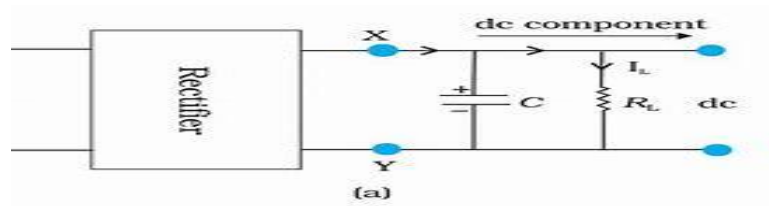
### Capacitor:

- Capacitor is a passive electronic component that store energy in the form of electrostatic field.
- It consists of two conducting plates separated by an insulating material called dielectrics.
- Capacitor blocks the flow of DC components & allow the flow of AC components

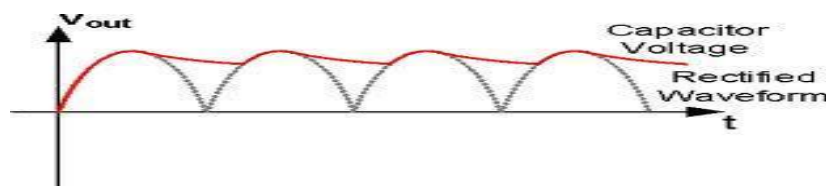
### (1) Capacitor Filter:

- It consists of capacitor (C) placed across the rectifier o/p in parallel with the load resistor.

### Circuit diagram:



- The pulsating direct voltage of the rectifier is applied across the capacitor.
- As the rectifier voltage increases, it charges the capacitor & also supplies current to the load.
- At the end of the quarter cycle, the capacitor is charged to the peak voltage of capacitor voltage.
- Now the rectifier voltage starts to decrease. the capacitor discharges through the load as shown by the line.
- Voltage across loads will decrease slightly because immediately the next voltage peak comes & recharge capacitor.
- This process is repeated again & again and the o/p formed.

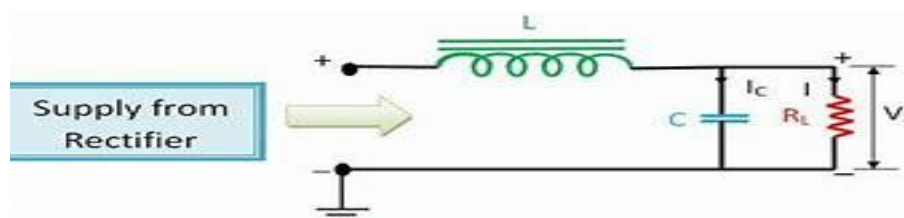


### Advantages-

- The capacitor filter circuit is extremely popular because of its low cost, small size, little weight & good characteristics.
- It is commonly used in battery eliminator.

### (2) Choke input filter:

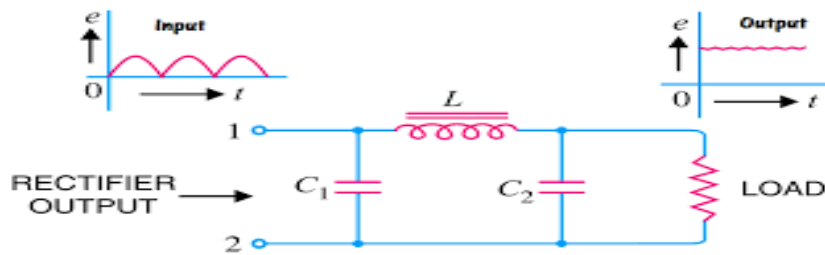
- It consists of choke (L) connected in series with the rectifier output & filter capacitor operates (C).



- The inductive reactance is  $X_L = 2\pi fL$ , for dc,  $f(\text{frequency}) = 0$  Then,  $X_L = 0$  Hence inductor allows the d.c to pass through it & blocks ac.
- When the pulsating output is applied the ac component is blocked by the series Inductor L, only dc component passes through it. If the resultant output have any ac component it bypass through the parallel capacitor C and the pure dc component will appear across load

- In this way filter circuit has filtered out the AC components from the rectifier output & allow DC components to reach the load.

### (3) Capacitor I/P Filter (II Filter):



- In this case an additional capacitor (C) is connected in beginning across o/p terminal of rectifier.
- It's shape like a greek letter  $\pi$  show it is named as  $\pi$  filter.
- In this filter (L) is connected in series &  $C_1C_2$  connected to parallel with the load.
- Here pulsating output from rectifier is applied across 1st capacitor  $C_1$  which offers zero reactance to ac & infinite reactance to dc.
- Hence dc component continues to reach across (Choke Filter)  $L$ . The filter choke then allows the dc component easily by blocking ac component if any.
- Finally the 2nd capacitor  $C_2$  across load bypasses the ac component if any which the choke ( $L$ ) failed to block by making dc component to reach across load.

### Advantages-

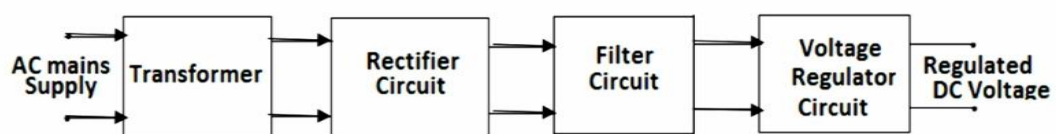
- It can be used with half wave as well as full-wave rectifier
- Ripples are almost zero
- O/p is almost pure DC

### Disadvantages-

- Cost, size & weight effective

## 2.4 WORKING OF DC POWER SUPPLY SYSTEM (UNREGULATED) WITH HELP OF BLOCK DIAGRAM ONLY:

### Block diagram:



**Block Diagram of DC Regulated Power Supply**

- When we design any electronics circuit, we need a DC voltage source. so we can easily design the constant DC source using the above circuit diagram.

### Transformer-

- The transformer i/p is 230 v AC voltage at primary winding & lower voltage in secondary winding because of step down transformer.

### Rectifier-

- Rectifier converts AC voltage to pulsating DC voltage.

### Filter-

- The function of filter circuit is to remove the AC components from the rectifier o/p & provide pure DC.

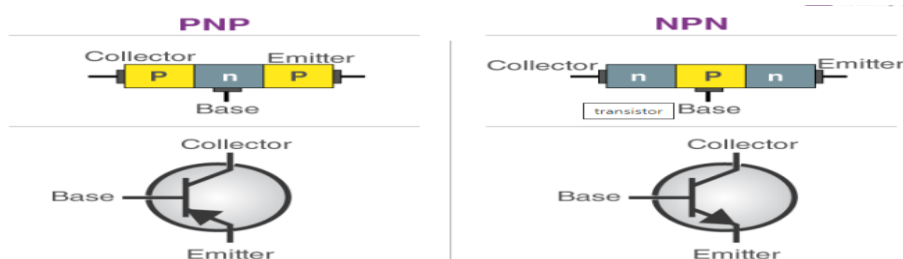
### Voltage Regulator-

- The voltage regulator receive the unregulated dc voltage from the filter circuit & deliver constant regulated voltage.

## 2.5 TRANSISTOR, DIFFERENT TYPES TRANSISTOR CONFIGURATION & STATE OUTPUT & INPUT CURRENT GAIN RELATIONSHIP IN CE, CB & CC CONFIGURATION (NO MATHEMATICAL DERIVATION):

### Transistor-

- The transistor is a three terminal semiconductor device that regulates current or voltage flow and acts as a switch or gate for signals.
- The transistor is a semiconductor device which transfers a weak signal from low resistance circuit to high resistance circuit.
- The words **trans** mean transfer property and **istor** mean resistance property offered to the junctions.
- A transistor consists of two pn junctions formed by sandwiching either p-type or n-type semiconductor between a pair of opposite types. Also we can say The transistor consists two PN diode connected back to back. Hence it has got two PN junctions.
- Accordingly there are two types of transistors namely;
  - (i)n-p-n transistor
  - (ii)p-n-p transistor
- An n-p-n transistor is composed of two n-type semiconductors separated by a thin section of p-type and a p-n-p transistor is formed by two p-sections separated by a thin section of n-type as shown in Figure.



- The three terminals drawn from the transistor indicate Emitter (E), Base (B) and Collector (C) terminals. They have their functionality as discussed below.

#### Emitter

- The left-hand side of the above shown structure can be understood as Emitter.
- This has a moderate size and is heavily doped as its main function is to supply a number of majority carriers, i.e. either electrons or holes.
- As this emits electrons, it is called as an Emitter.
- This is simply indicated with the letter E.

#### Base

- The middle material in the above figure is the Base.
- This is thin and lightly doped.
- Its main function is to pass the majority carriers from the emitter to the collector.
- This is indicated by the letter B.

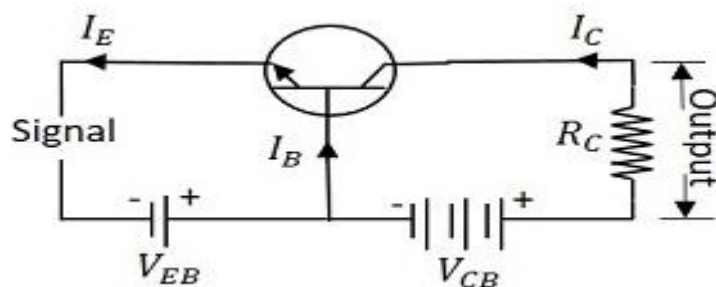
#### Collector

- The right side material in the above figure can be understood as a Collector.
- Its name implies its function of collecting the carriers.
- This is a bit larger in size than emitter and base. It is moderately doped.
- This is indicated by the letter C.

### Transistor Configurations-

- There are three types of transistor configuration,
  - (a) Common Base Configuration.
  - (b) Common Emitter Configuration.
  - (c) Common Collector Configuration.

#### Common Base Configuration



- In this above circuit diagram, the i/p is given between base & emitter, and the o/p is taken between base & collector.
- Since the base is common to both i/p & o/p so this connection is known as common base configuration.
- Emitter current ( $I_E$ ) is the i/p current & collector current ( $I_C$ ) is o/p current.

#### Current Gain Amplification Factor(A)-

- As The o/p of transistor may be DC signal or AC signal. so current gain amplification factor can be divided into two types ,
  - AC current gain( $\alpha_0$ )
  - DC current gain ( $\alpha$ )

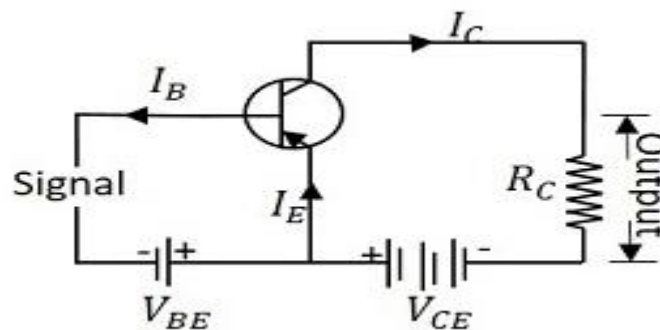
### AC current gain-

- It is ratio between the change in o/p current( $\Delta I_c$ ) to the change in i/p current( $\Delta I_e$ ).  
Mathematically,  $\alpha = \Delta I_c / \Delta I_e$

### DC current gain( $\alpha$ )-

- It is ratio between the change in o/p current ( $I_c$ ) to the change in i/p current ( $I_e$ )  
Mathematically,  $\alpha = I_c / I_e$ .

### Common emitter connection:

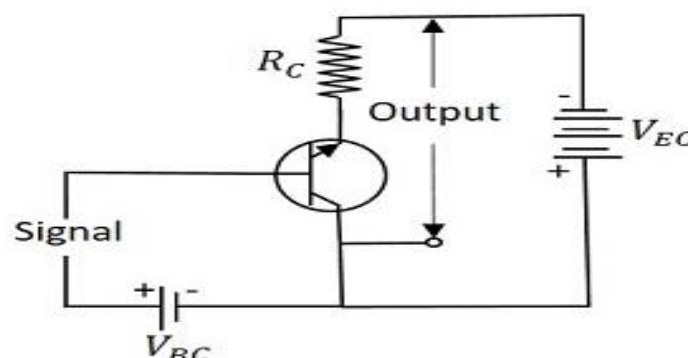


- The Emitter is common to both i/p & o/p ,so it is called common emitter configuration .
- Here the i/p is given between base & emitter ,and the o/p is taken between emitter & collector.
- Base current ( $I_b$ ) is the i/p current & collector current ( $I_c$ ) is o/p current.

### Current Gain Amplification Factor(B):

- It is ratio between the change in o/p current( $\Delta I_c$ ) to the change in i/p current( $\Delta I_b$ ).  
Mathematically ,  $\beta = \Delta I_c / \Delta I_b$

### Common Collector Configuration:



- The collector is common to both i/p & o/p ,so it is called common collector configuration
- Above circuit diagram in this the i/p is given between base & collector ,and the o/p is taken between emitter & collector.
- Base current ( $I_b$ ) is the i/p current & collector current ( $I_c$ ) is o/p current.

### Current Gain Amplification Factor( $\Delta$ )-

- It is ratio between the change in o/p current( $\Delta I_c$ ) to the change in i/p current( $\Delta I_b$ )  
Mathematically,  $\lambda = \Delta I_c / \Delta I_b$

#### Relation between $\alpha$ , $\beta$ and $\gamma$

Relation between  $\alpha$  and  $\beta$ :  $\beta = \frac{\alpha}{1-\alpha}$  also  $\alpha = \frac{\beta}{1+\beta}$

Relation between  $\alpha$  and  $\gamma$ :  $\gamma = \frac{1}{1-\alpha}$  also  $\alpha = \frac{\gamma-1}{\gamma}$

Relation between  $\beta$  and  $\gamma$ :  $\gamma = 1 + \beta$  also  $\beta = \gamma - 1$

Relation between  $\alpha, \beta$  and  $\gamma$ :  $\alpha = \frac{\beta}{1+\beta}$ ,  $\beta = \frac{\alpha}{1-\alpha}$ ,  $\gamma = \frac{1}{1-\alpha}$ ,  $\beta = \alpha \times \gamma$ ,  $\gamma = 1 + \beta$ ,  $\beta = \gamma - 1$

## 2.6 NEED OF BIASING & EXPLAIN DIFFERENT TYPES OF BIASING WITH CIRCUIT DIAGRAM (ONLY CE - CONFIGURATION):

### Transistor Biasing –

- The proper flow of zero signal collector current  $I_c$  & maintain proper collector ,emitter voltage  $V_{ce}$  during the passage of signal is known as transistor biasing.
- Transistor biasing make the base emitter junction is forward biased& emitter collector junction is reverse biased.

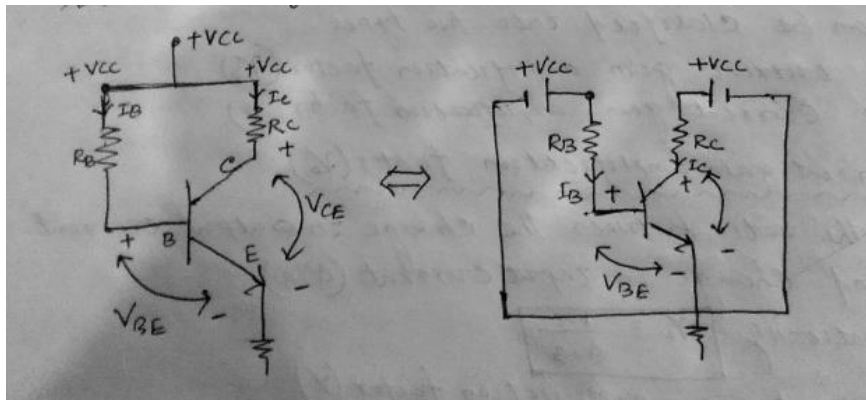
### Need of biasing-

- Transistor biasing is needed for Faithfull amplification.

### Types of biasing-

- There are three types of transistors biasing such as
  - (a) Fixed biasing
  - (b) Feedback resistor biasing
  - (c) Voltage divider biasing

### a) Fixed Biasing-



Applying KVL at i/p side –

$$+V_{cc} - I_B R_B - V_{BE} = 0$$

$$\Rightarrow I_B = (V_{cc} - V_{BE}) / R_B$$

Out put current-

$$I_c = \beta I_B = \beta [(V_{cc} - V_{BE}) / R_B] \quad \therefore (\beta = I_c / I_B)$$

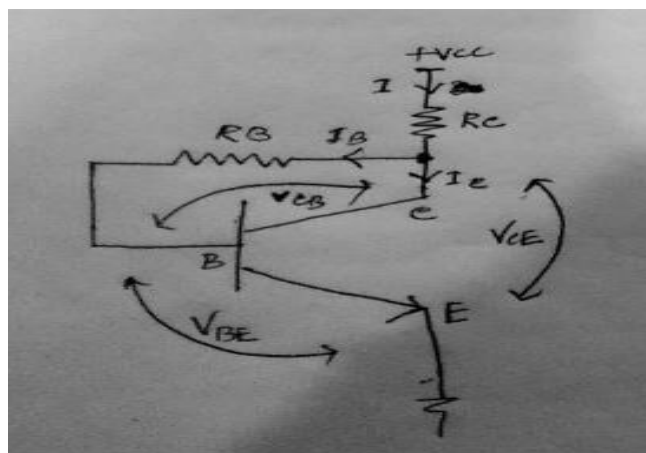
Applying KVL at o/p side

$$+V_{cc} - I_c R_c - V_{CE} = 0$$

$$\Rightarrow V_{CE} = V_{cc} - I_c R_c$$

- In this method the high resistance value is connected between the base & +ve end of the  $V_{cc}$  supply for NPN transistor.
- Here zero signal base current is provided by  $V_{cc}$  & it flows through  $R_b$  because base emitter junction is forward biased.
- The required value of zero signal base current  $I_b$  can be made to flow by selecting proper value of base resistor  $R_b$ .

### b) Feedback resistor biasing-



- In the biasing one end of  $R_B$  is connected to the base & the other end to the collector as shown in above fig.

Applying KCL

$$I = I_c + I_B$$

Applying KVL at input loop

$$V_{cc} - I R_c - I_B R_B - V_{BE} = 0$$

$$\Rightarrow V_{cc} - (I_c + I_B) R_c - I_B R_B - V_{BE} = 0$$

$$\Rightarrow V_{cc} - (\beta I_B + I_B) R_c - I_B R_B - V_{BE} = 0 \quad (\because \beta = I_c / I_B)$$

$$\Rightarrow V_{cc} - [(\beta + 1) R_c + R_B] I_B - V_{BE} = 0$$

$$\Rightarrow I_B = (V_{cc} - V_{BE}) / [(\beta + 1) R_c + R_B]$$

$$\Rightarrow I_c = \beta I_B = \beta (V_{cc} - V_{BE}) / [(\beta + 1) R_c + R_B]$$

Applying KVL at o/p loop

$$V_{cc} - I R_c - V_{CE} = 0$$

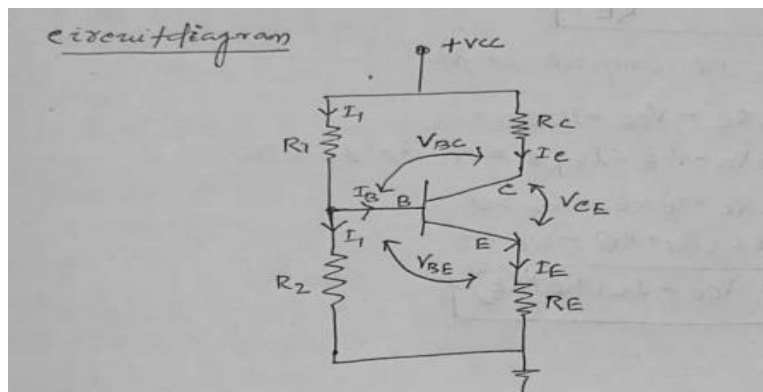
$$\Rightarrow V_{cc} - (I_c + I_B) R_c - V_{CE} = 0$$

$$\Rightarrow V_{cc} - (I_c + I_B) R_c = V_{CE}$$

### c) Voltage Divider Biasing–

- -This is the most widely used method of providing biasing & stabilization to a transistor .
- -In this method two resistance  $R_1$  &  $R_2$  are connected across the supply voltage  $V_{cc}$  & provide biasing .
- -The emitter resistance  $R_E$  provides stabilization .
- Here the voltage divided by  $R_1$  &  $R_2$  resistor & the voltage drop across  $R_2$  , forward biases the base emitter junction .

### Circuit diagram



- Current flowing through the resistance  $R_1$  is  $I_1$  , as the base current  $I_B$  is very small. Therefore current flowing through  $R_2$  is also  $I_1$

$$I_E = I_c + I_B$$

$$\Rightarrow I_E \approx I_c (\because I_B \text{ is very small so it neglected})$$

Collector current ( $I_c$ )

- According to ohm's law ( $I = V/R$ )  

$$\Rightarrow I_1 = V_{cc} / (R_1 + R_2)$$

Let voltage drop across  $R_2$  is  $V_2$

$$\Rightarrow V_2 = I_1 * R_2$$

$$\Rightarrow V_2 = V_{cc} / (R_1 + R_2) * R_2$$

Applying KVL at input side

$$\Rightarrow V_2 - I_E R_E - V_{BE} = 0$$

$$\Rightarrow V_2 - I_C R_E - V_{BE} = 0 \quad (I_E = I_C)$$

$$\Rightarrow I_C = (V_2 - V_{BE}) / R_E$$

Applying KVL at output side

$$V_{cc} - I_C R_C - I_E R_E - V_{CE} = 0$$

$$\Rightarrow V_{cc} - I_C R_C - I_C R_E - V_{CE} = 0 \quad (I_E = I_C)$$

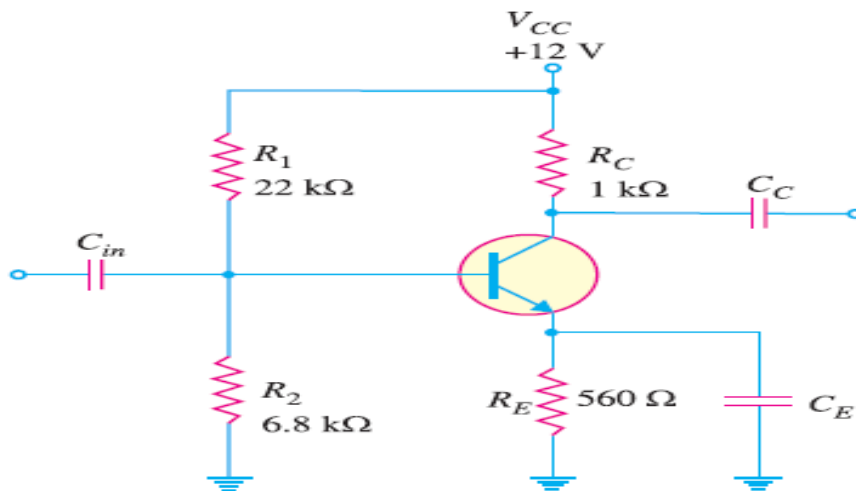
$$\Rightarrow V_{cc} - I_C (R_C + R_E) - V_{CE} = 0$$

$$\Rightarrow V_{CE} = V_{cc} - I_C (R_C + R_E)$$

## 2.7 AMPLIFIERS(CONCEPT), WORKING PRINCIPLE OF SINGLE-PHASE CE AMPLIFIER:

### Amplifier-

- Amplifier is the electronics circuit which raises the strength of weak signal is called amplifier.



- When in an amplifier circuit only one transistor is used for amplifying a weak signal, the circuit is known as single stage amplifier. A single stage CE amplifier has one common emitter transistor, bias circuit & other auxiliary components as shown in figure.
- When a weak ac. signal is applied to the base of the transistor, a small base current starts flowing in the input circuit.
- Due to transistor action, a much larger ( $\beta$  times the base current) ac. current flows through the load  $R_C$  in the output circuit. Since the value of load resistance  $R_C$  is very high, a large voltage will drop across it.
- Thus, a weak signal applied in the base circuit appears in amplified form in the collector circuit. In this way the transistor acts as an amplifier.

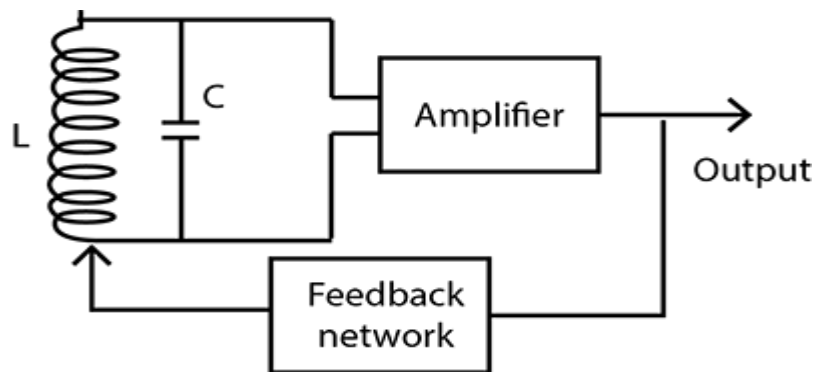
- The resistances R1 , R2 and RE provide biasing and stabilization. An electrolytic capacitor of value 10  $\mu$ F is used to couple the signal to the base of the transistor.
- An emitter bypass capacitor of value 100  $\mu$ F is used in parallel with RE to provide a low reactance path to the amplified a.c. signal.
- The coupling capacitor of value 10  $\mu$ F is used to couple one stage of amplification to the next stage.
- The voltage gain of a single stage transistor amplifier is the ratio of a.c. output voltage to a.c. input signal voltage.

## 2.8 ELECTRONIC OSCILLATOR & IT'S CLASSIFICATION:

### Oscillator-

- An oscillator is a circuit which produces a continuous repeated alternating wave form without any input. It is used for measurement of different types of wave signal.
- There various types of oscillator such as ,
  - (a) Hartley oscillator
  - (b) Colpitts oscillator
  - (c) Wien bridge oscillator
  - (d) Phase shift oscillator
  - (e) Crystal oscillator

## 2.9 WORKING OF BASIC OSCILLATOR WITH DIFFERENT ELEMENT THROUGH SIMPLE BLOCK DIAGRAM:



- The importance components of a transistor oscillator is
  - 1- Tank circuit (LC Ckt)
  - 2- Transistor amplifier
  - 3- Feedback circuit

### Tank circuit-

- It is responsible for generation of desirable amount of frequency
- This circuit consist of inductor (L) & capacitor (C) connected in parallel
- The frequency of oscillator circuit depends upon the value of L & C .
- The frequency is required with L&C by the formula,

$$f_0 = 1 / 2\pi LC$$

### Transistor amplifier circuit-

- It is a circuit which amplified the weak signal
- The amplifier stage is generally used to provide the necessary strength as the signal is weak

### **Feedback circuit-**

- It is used for feedback the o/p of transistor amplifier to the tank circuit

## **POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER**

### **Q.1 - What Is Rectifier?**

Rectifier is an electronics device which convert alternating current to direct current

### **Q.2- What Are the disadvantages Of Half Wave Rectifier**

Ans- Disadvantage of half wave rectifier-

- The pulsating current in the load contains AC components whose basic frequency is equal to the supply frequency
- It is low efficiency like 40.6%

### **Q.3-What Are The Disadvantages Of Center Tape Full wave Rectifier ?**

Ans- Disadvantage of center tape full wave rectifier

- It is expensive to manufacture center tape transformer ,in which produce equal voltage of each half of secondary winding

### **Q.4- What Is The Function Of Filter Circuit ?**

Ans- A filter is a device which removes the AC component of rectifier o/p & allow the pure DC to the load resistor

### **Q.5- What Is Ripple Factor.[W-18]**

Ans- It is the ratio of rms value of AC components present in rectifier o/p to the avg value of rectifier o/p

### **Q.6- What Is Transistor?**

Ans It is a semiconductor device which amplify the signal & control the current

### **Q.7- How many Transistors Biasing Are Present**

Ans There are three types of transistor biasing such as

- (a) fixed biasing
- (b) Feedback resistor biasing
- (c) Voltage divider biasing

### Q-8- What Is Biasing & Need Of Biasing?[W-18,S-19]

Ans- The proper flow of zero signal collector current  $I_c$  & maintain proper collector, emitter voltage  $V_{ce}$  during the passage of signal is known as transistor biasing

Need of biasing-

- Transistor Biasing is needed for truthful amplification

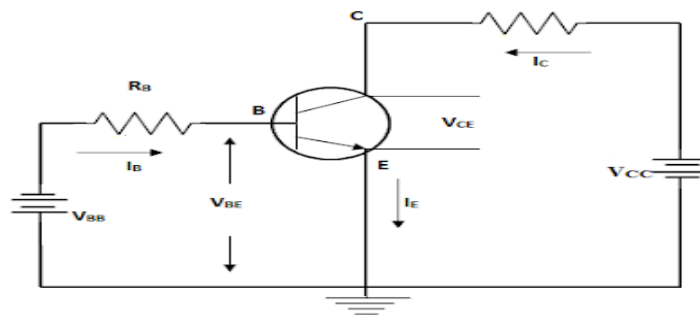
### Q.9 –What Is Amplifier?

Ans- Amplifier is the electronics circuit which raises the strength of weak signal is called amplifier

### Q.10-What Is Oscillator?

Ans- An oscillator is a circuit which produces a continuous repeated alternating wave form with out any i/p

### Q.11-Draw the CE configuration of transistor.[W-22]



## POSSIBLE LONG TYPE QUESTION

Q.1- Describe rectifier & explain half wave rectifier.

Q.2- Explain bridge type full-wave rectifier.[W-18,W-19]

Q.3- What is filter& explain  $\pi$  type filter details.[W-18,W-19]

Q.4- Explain fixed biasing.

Q.5-Explain voltage divider biasing.

Q.6- Write short notes on basic oscillator with the block diagram.[W-22]

Q.7- Explain working principle of single stage common emitter transistor amplifier.

Q.8- Explain different types of basic filter circuit diagram with proper diagram.[W-22]

# CHAPTER NO.- 03

## COMMUNICATION SYSTEM

### LEARNING OBJECTIVES-

3.1 Basic communication system (concept & explanation with help of block diagram)

3.2-concept of modulation & demodulation, difference between them.

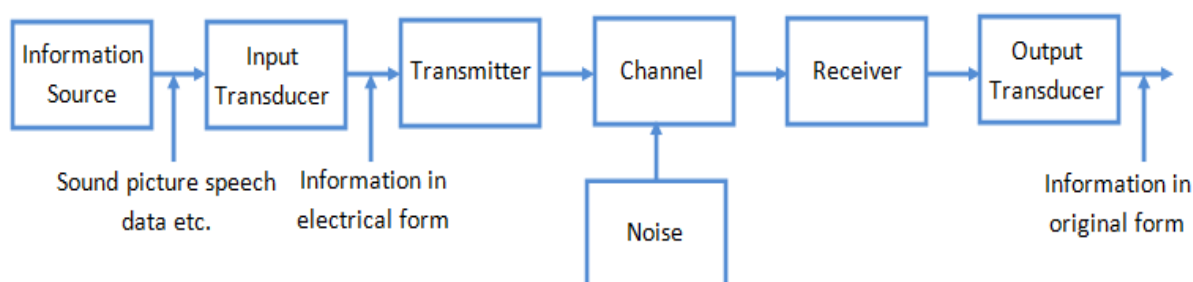
3.3- Different types of modulation (AM, FM & PM) based on signal, carrier wave & modulated wave (no mathematical derivation).

### **Communication:**

- Communication is the process of exchanging the information.
- Communication is the process of connection or link between two point for information sharing.
- The process of transmission and reception of information is called communication.

### **3.1 BASIC COMMUNICATION SYSTEM (CONCEPT & EXPLANATION WITH DIAGRAM):**

- The block diagram given below represents the flow of the signal from the source to the destination.



#### **Information Source**

- Message or information is the entity that is to be transmitted. It can be in the form of audio, video, temperature, picture, pressure, etc.

#### **Input Transducer**

- A transducer is a device which converts one form of energy into another form.
- The message from the information source may or may not be electrical in nature. In a case when the message produced by the information source is not electrical in nature, an input transducer is used to convert it into a time-varying electrical signal.
- Example: microphone converts the information or message which is in the form of sound waves into corresponding electrical signal.

#### **Transmitter**

- It is the arrangement that processes the message signal into a suitable form for transmission and subsequently reception.
- Modulation is the main function of the transmitter. In modulation, the message signal is superimposed upon the high-frequency carrier signal.

#### **Channel**

- A channel refers to a physical medium such as wire, cables, space through which the signal is

passed from transmitter to the receiver.

- There are many channel impairments that affect the channel performance to a pronounced level. Noise, Attenuation and distortion to mention the major impairments.

### Noise

- Noise is an unwanted signal which tend to interfere with the required signal. Noise signal is always random in character. Noise may interfere with signal at any point in a communication system.

### Receiver

- An arrangement that extracts the message or information from the transmitted signal at the output end of the channel and reproduces it in a suitable form as the original message signal is a receiver.
- The main function of the receiver is to reproduce the message signal in electrical form from the distorted received signal. This reproduction of the original signal is accomplished by a process known as the demodulation or detection. Demodulation is the reverse process of modulation carried out in transmitter.

### Output transducer

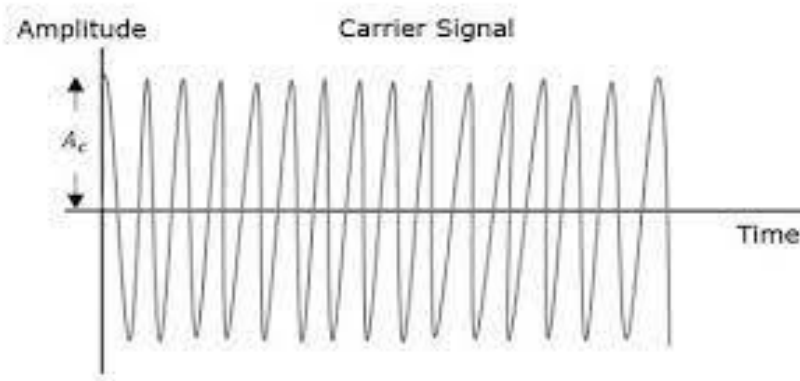
- Output transducer convert an electrical message signal into its original form.
- Example- loudspeaker which works as a transducer i.e. converts the electrical signal in the form of original sound signal.

## 3.2 CONCEPT OF MODULATION & DEMODULATION, DIFFERENCE BETWEEN THEM:

- The process of changing some characteristic like amplitude, frequency and phase of carrier wave in accordance with the intensity of the original signal is called modulation.

### Carrier signal:

- It is a high frequency signal. As the name indicate the function is to carry the information or modulating signal from the transmitter to receiver.



### Need for modulation: -

- Modulation is extremely necessary in communication system due to the following reason
  1. Practical antenna length.
  2. Operating range.
  3. Wireless communication.

**Demodulation-** It is defined as extracting the original information-carrying signal from a modulated

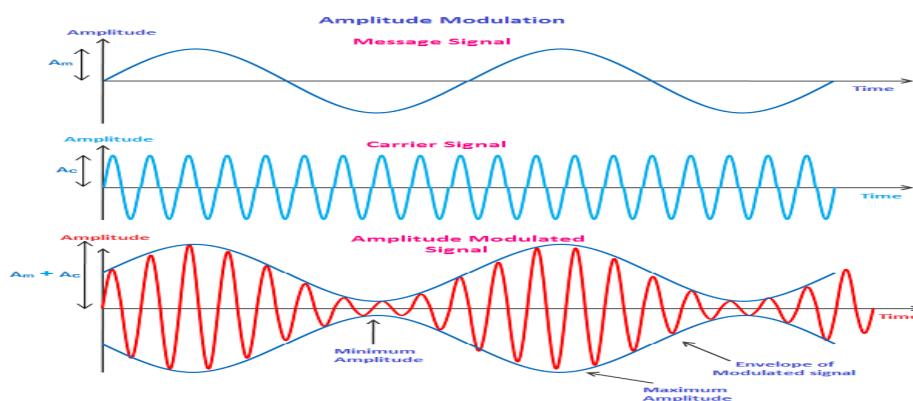
carrier wave. A demodulator is an electronic circuit that is mainly used to recover the information content from the modulated carrier wave.

### **Difference between modulation and demodulation-**

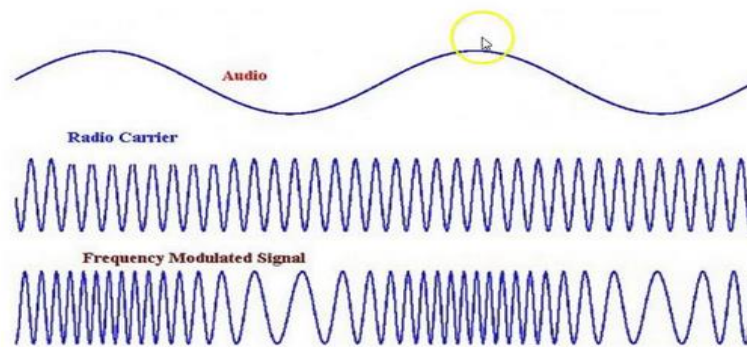
Parameter	Modulation	Demodulation
Definition	Modulation is the process of varying the parameter of the carrier signal according to message bearing signal.	Demodulation is the process by which message signal is extracted from the modulated wave.
Operating End	Transmitting end	Receiving end
Operation	Simple	Complex
Frequency	Low to high	High to low
Purpose	The main purpose of modulation is to transmit the messages to long distances.	The purpose of demodulation is to regain the original message at the receiver end.

### **3.3 DIFFERENT TYPES OF MODULATION (AM, FM & PM) BASED ON SIGNAL, CARRIER WAVE & MODULATED WAVE (ONLY CONCEPT NO MATHEMATICAL DERIVATION):**

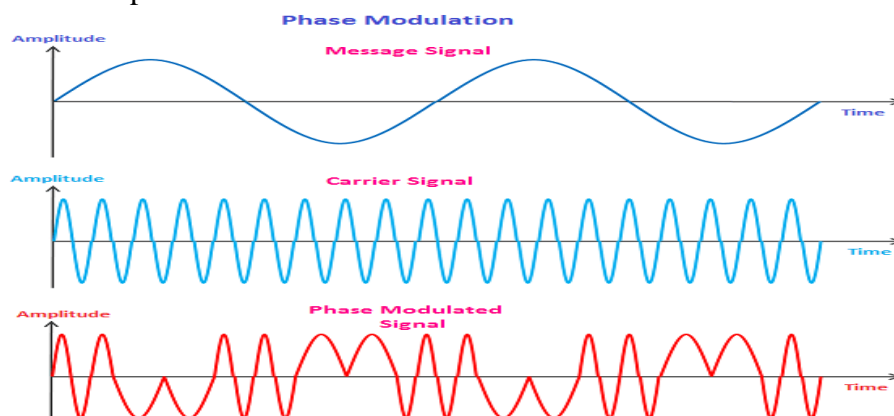
- i. Amplitude modulation
  - ii. Frequency modulation
  - iii. Phase modulation
- i. Amplitude modulation- When the amplitude carrier wave is changed in accordance with the intensity of the signal is called amplitude modulation



- ii. Frequency modulation- When the frequency of carrier wave is changed in accordance with the intensity of the original signal is called frequency modulation.



- iii. Phase modulation- When the phase of carrier wave is changed in accordance with the intensity of the original signal is called phase modulation.



## **POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER**

### **Q1-Define and classify modulation.[W-22]**

**Ans.** The process of changing some characteristic like amplitude, frequency and phase of carrier wave in accordance with the intensity of the signal is called modulation.

Modulation are classified into 3 types

- i) Amplitude modulation
- ii) Frequency modulation
- iii) Phase modulation

### **Q2-What is carrier wave and modulated wave?**

**Ans.** Carrier is a wave form usually sinusoidal that is modulated with input signal for the purpose of conveying information. This carrier wave is usually a much higher frequency than the input signal.

- Modulation is the process of varying one or more properties of a periodic wave form called the carrier signal with a modulating signal that typically contains information to be transmitted.

### **Q3. Define amplitude modulation?**

**Ans.** When the amplitude of high frequency carrier wave is changed in accordance with the

intensity of signal is called amplitude modulation.

**Q4. Define frequency modulation? [s-18]**

**Ans.** When the frequency of a carrier wave is changed in accordance with the intensity of the signal is called frequency modulation.

**POSSIBLE LONG TYPE QUESTIONS**

**Q1.** Write difference between AM & FM?

**Q2.** Explain the communication system with help of block diagram? [W-20]

**Q3.** Explain briefly about the Amplitude Modulation.[S-19]

**Q4.** Describe Amplitude Modulation and Frequency Modulation in details.[W-22]

## **CHAPTER NO.- 04**

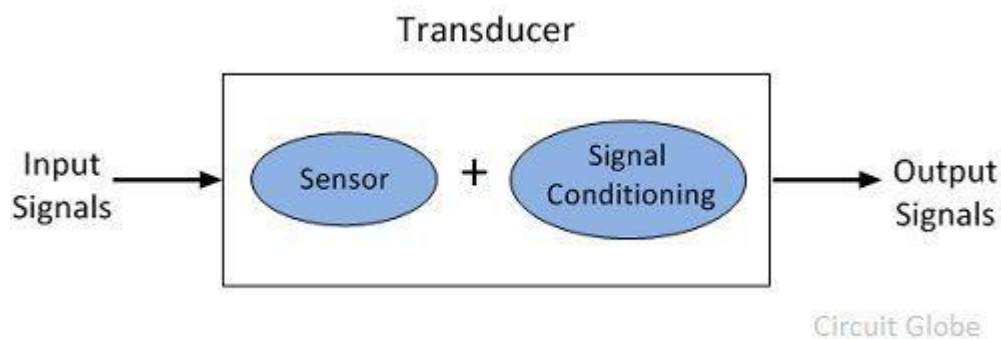
### **TRANSDUCER AND MEASURING INSTRUMENT**

#### **LEARNING OBJECTIVES-**

- 4.1- Concept of Transducer & sensor with their difference.
- 4.2-Different types of transducer & concepts of active & passive transducer.
- 4.3 Working principle of Photo emissive, photoconductive, photovoltaic transducer & it's application.
- 4.4 Multimeter & it's application.
- 4.5 Analog and digital multimeter and their difference.
- 4.6 Working principle of multimeter with basic block diagram.
- 4.7 CRO, Working principle of Cathode ray oscilloscope with simple block diagram.

#### **4.1-CONCEPT OF TRANSDUCER & SENSOR WITH THEIR DIFFERENCE:**

- A transducer is a device which converts the energy from one form to another form that is mechanical force to electrical energy.
- The process of energy conversion in the transducer is known as the transduction.
- The transduction is completed into two steps. First by sensing the signal and then strengthening it for further processing.
- The transducer has three major components; they are the input device, signal conditioning or processing device and an output device.
- The input devices receive the measurand quantity and transfer the proportional analogue signal to the conditioning device. The conditioning device modified, filtered, or attenuates the signal which is easily acceptable by the output devices.



#### **sensor-**

- The sensor is a device that measures the physical quantity (i.e. Heat, light, sound, etc.) into an easily readable signal (voltage, current etc.). It gives accurate readings after calibration.

## **Difference between primary sensor and transducer-**

The following are the key differences between the sensor and transducer.

1. The sensor senses the physical change across the surrounding whereas the transducer transforms the one form of energy into another.
2. The sensor itself is the major component of the sensor, whereas the sensor and the signal conditioning are the major elements of the transducer.
3. The primary function of the sensor is to sense the physical changes, whereas the transducer converts the physical quantities into an electrical signal.
4. The accelerometer, barometer, gyroscope are the examples of the sensors whereas the thermistor, and thermocouple is the examples of the transducer.

## **4.2-DIFFERENT TYPES OF TRANSDUCER & CONCEPT OF ACTIVE & PASSIVE TRANSDUCER:**

The classification of transducers is made from the following basis:

1. Based on the physical phenomenon
  - ♣ Primary transducer
  - ♣ Secondary transducer
2. Based on the power type Classification
  - ♣ Active transducer
  - ♣ Passive transducer
3. Based on the type of output the classification of transducers are made
  - ♣ Analog transducer
  - ♣ Digital transducer
4. Based on the electrical phenomenon is a best Classification of Transducers
  - ♣ Resistive transducer
  - ♣ Capacitive transducer
  - ♣ Inductive transducer
  - ♣ Photoelectric transducer
  - ♣ Photovoltaic transducer
5. Based on the non-electrical phenomenon Classification of transducer
  - ♣ Linear displacement
  - ♣ Rotary displacement
6. Based on the transduction phenomenon
  - ♣ Transducer
  - ♣ Inverse transducer.

## **Concept of Active & Passive transducer-**

### **Active Transducer:**

- The transducer which does not require the external power source is known as the active transducer.
- Such type of transducer develops their own voltage or current, hence known as a self generating transducer.

- The energy required for generating the output signals are obtained from the physical quantity which is to be measured.

Ex-: Thermocouple & photovoltaic cell.

### **Passive Transducer:**

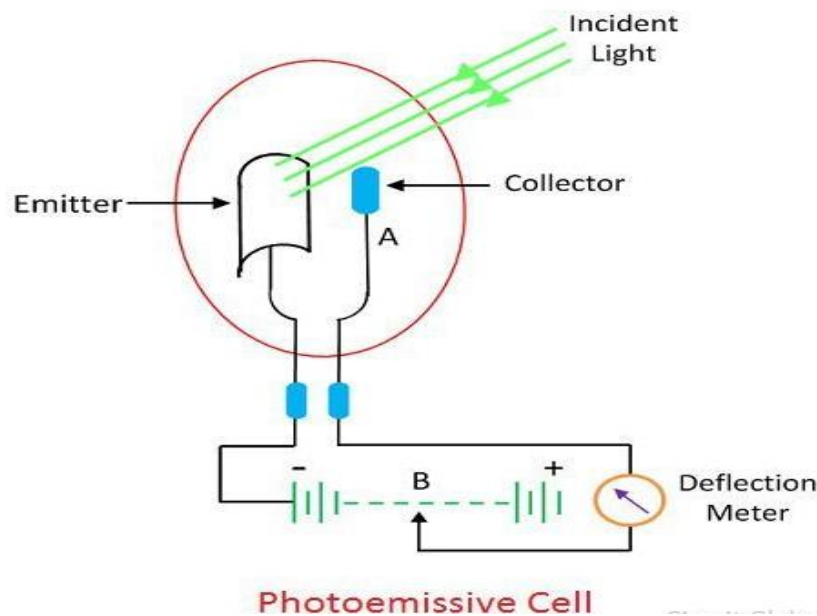
- The transducer which requires the power from an external supply source is known as the passive transducer.
- They are also known as the external power transducer. The capacitive, resistive and inductive transducers are the example of the passive transducer.
- The passive transducer takes power from the external energy source for transduction. The word transduction means conversion of energy from one form to another.

Ex- Hall effect generator

## **4.3-WORKING PRINCIPLE OF PHOTO EMISSIVE, PHOTOCONDUCTIVE, PHOTOVOLTAIC TRANSDUCER & IT'S APPLICATION:**

### **Photo Emissive Transducer:**

- The Photo-emissive cell converts the photons into electric energy. It consists the anode and the cathode plate. The anode and cathode are coated with Photo-emissive material called caesium antimony.

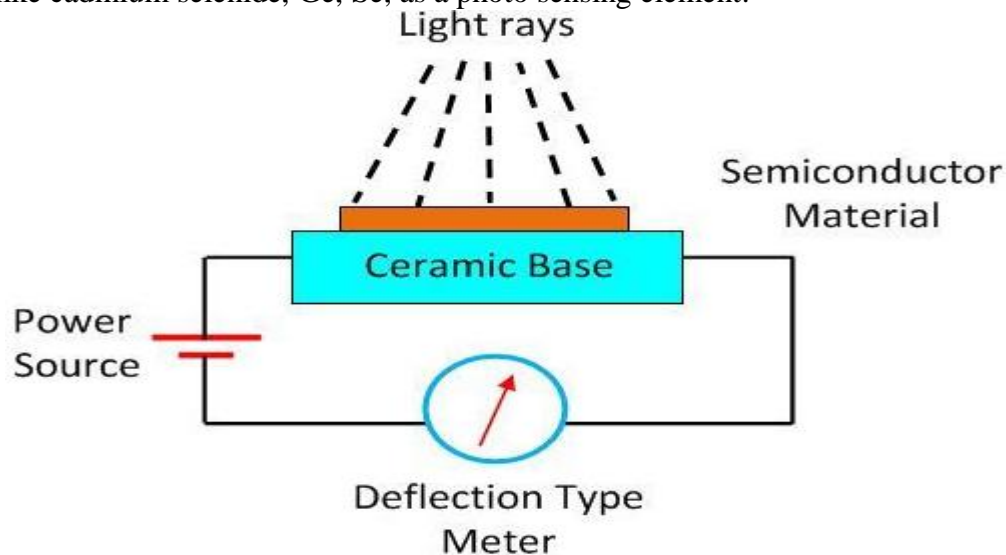


**Photoemissive Cell**

- When the radiation of light falls on cathode plates the electrons start flowing from anode to cathode. Both the anode and the cathode are sealed in a closed, opaque evacuated tube. When the radiation of light falls on the sealed tube, the electrons start emitting from the cathode and move towards the anode.
- The anode is kept to the positive potential. Thus, the photoelectric current starts flowing through the anode. The magnitude of the current is directly proportional to the intensity of light passing through it.

### Photoconductive transducer-

- The photoconductive cell converts the light energy into an electric current. It uses the semiconductor material like cadmium selenide, Ge, Se, as a photo sensing element.

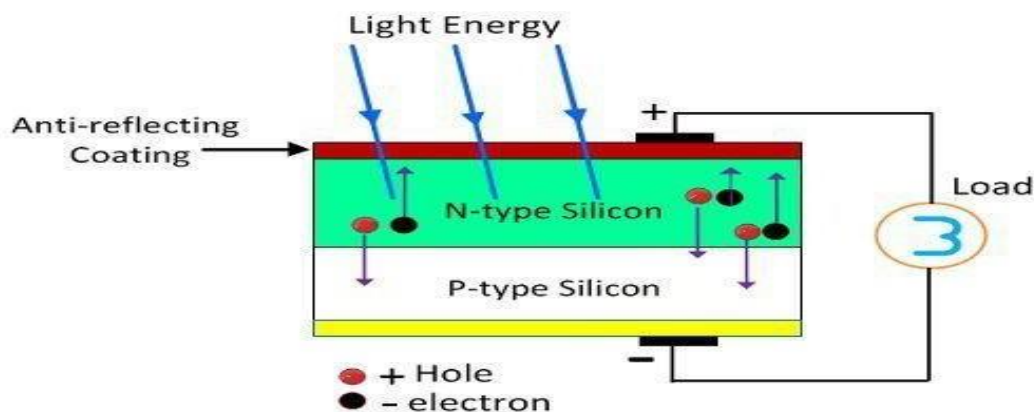


- When the beam of light falls on the semiconductor material, their conductivity increases and the material works like a closed switch. The current starts flowing into the material and deflects the pointer of the meter.

### Application-

- 1) It records body movement.

### Photo voltaic transducer-



- The photovoltaic cell is the type of active transducer. The current starts flowing into the photovoltaic cell when the load is connected to it. The silicon and selenium are used as a semiconductor material. When the semiconductor material absorbs heat, the free electrons of the material starts moving. This phenomenon is known as the photovoltaic effect.

- The movements of electrons develop the current in the cell, and the current is known as the photoelectric current
- Application- They can be used as energy converter used in space craft, data processing industries.

#### 4.4-MULTIMETER &IT'S APPLICATION

- A multimeter is an electronic measuring instrument that combines several measurement functions in one unit.
- A typical multimeter can measure voltage, current, and resistance. It is an indispensable instrument and can be used for measuring dc as well as ac voltages and currents.
- Multimeter is the most inexpensive equipment and can make various electrical measurement with reasonable accuracy

##### Application-:

- 1.For checking the circuit continuity.
- 2.For measuring dc current flowing through the cathode, plate, screen and other vacuum tube circuits.
- 3.For measuring dc voltages across various resistors in electric circuits.
4. For measuring ac voltages across power supply transformers.
- 5.For ascertaining whether or not open or short circuit exists in the circuit under study.

#### 4.5-ANALOG AND DIGITAL MULTIMETER AND THEIR DIFFERENCE:

##### I. Analog multimeter

- Analog Multimeter is basically a moving coil instrument. A rectifier unit is also provided with the instrument. It is a multirange instrument and various ranges are obtained by different resistance elements in series or in parallel with the movement of the instrument. With the help of a rotary selector switch the various ranges are used.



##### II. Digital multimeter

- The digital multimeter is an instrument capable of measuring dc voltage, ac voltage, dc current, ac current, resistance, conductance and decibels. Thus DMM offers increased versatility. Some DMMs can measure the temperature, frequency etc.
- A DMM has a digital display and a function selector switch. The range selection takes place automatically. There are four input terminals, out of which two terminals are used for measurement of all the general purpose quantities such as ac/dc voltage, resistance, capacitance and diode, transistor

testing.

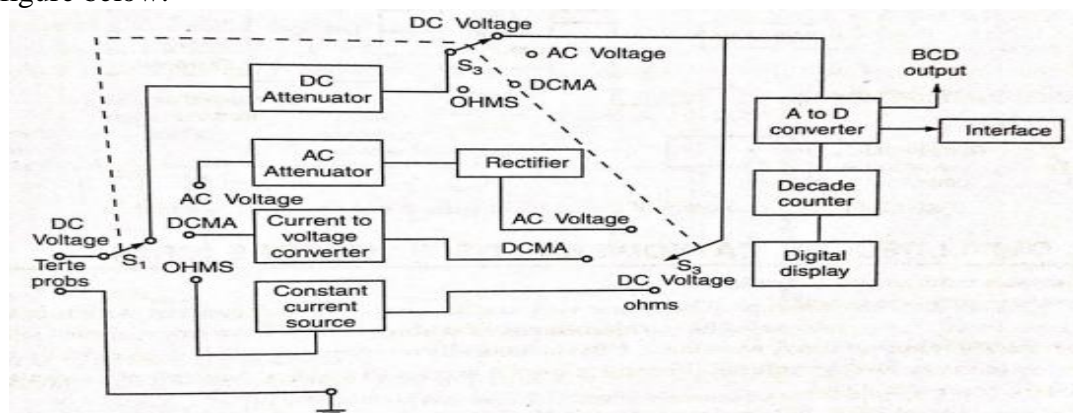


#### DIFFERENCE BETWEEN ANALOG AND DIGITAL MULTIMETER:

SL.NO.	Analog Multimeter	Digital Multimeter
01	Prone to error because of wrong pointer based reading.	Measures with great accuracy.
02	Power supply not required	Power supply required.
03	Calibration is done manually.	They are calibrated automatically before taking any measurement.
04	Less expensive	More expensive
05	Less costly as they offer very few features.	Expensive as they offer wide range of features.
06	Less isolation problem.	More isolation problem..
07	Construction is simple.	Construction is complicated.
08	Usually it measures current, voltage, and resistance.	Measures current, voltage, resistance, capacitance, and inductance as well.

#### 4.6-WORKING PRINCIPLE OF MULTIMETER WITH BASIC BLOCK DIAGRAM:

- All digital multimeters make use of some type of analog to digital converter (ADC). Generally dual slope integration type AD is used for this purpose. The block diagram of basic digital multimeter is as shown in figure below.



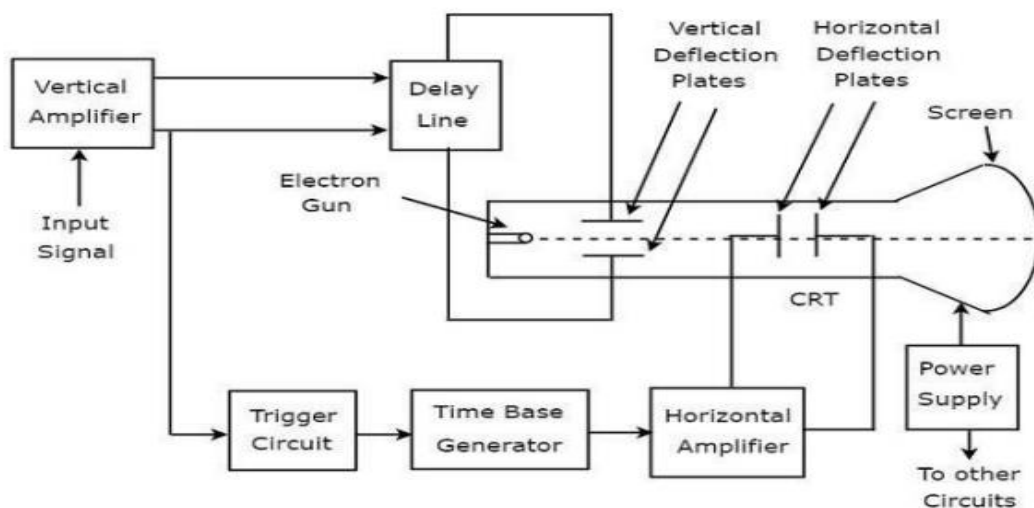
- A commercial digital multimeter consist of several A to D converters, decade counters and display. It is basically dc voltmeter. In order to measure unknown current; current to voltage converter is used. An unknown current to be measured is applied to one of the input terminals of op-amp. Since input impedance of op-amp is very high; very small current can pass through it. This current passing into the op-amp can be neglected.
- Thus  $I_{in} = I_{fb}$ , Here  $I_{fb}$  = feedback current
- This feedback current is allowed to pass through one of the known resistances. This current will cause a voltage drop across the resistance. This voltage is applied to analog to digital converter and finally digital display is obtained. Thus, output displayed on the digital display is directly proportional to unknown current.
- In order to measure an unknown resistance; a constant current source is used. The current from this constant current source is allowed to pass through unknown resistance. Thus the proportional voltage is obtained. The output disply is directly proportional to unknown resistance.
- To measure the ac voltage; a rectifier and filter is used. This rectifier converts ac signal into dc signal. Now, this dc signal is applied to A to D converter to the digital display. The BCD output can be obtained from A to D converter. Similarly, the output from digital multimeter can be used to interface with other equipments.

#### 4.7-CRO, WORKING PRINCIPLE OF CATHODE RAY OSCILLOSCOPE WITH SIMPLE BLOCK DIAGRAM:

- Oscilloscope is electronic equipment, which displays a voltage waveform. Among the oscilloscopes, Cathode Ray Oscilloscope (CRO) is the basic one and it displays a time varying signal or waveform.

##### Block diagram of CRO-

Cathode Ray Oscilloscope (CRO) consists a set of blocks. Those are vertical amplifier, delay line, trigger circuit, time base generator, horizontal amplifier, Cathode Ray Tube (CRT) & power supply. The block diagram of CRO is shown in below figure.



- Vertical Amplifier – It amplifies the input signal, which is to be displayed on the screen of CRT.
- Delay Line – It provides some amount of delay to the signal, which is obtained at the output of vertical amplifier. This delayed signal is then applied to vertical deflection plates of CRT.
- Trigger Circuit – It produces a triggering signal in order to synchronize both horizontal and vertical deflections of electron beam.
- Time base Generator – It produces a sawtooth signal, which is useful for horizontal deflection of electron beam.
- Horizontal Amplifier – It amplifies the sawtooth signal and then connects it to the horizontal deflection plates of CRT.
- Power supply – It produces both high and low voltages. The negative high voltage and positive low voltage are applied to CRT and other circuits respectively.
- Cathode Ray Tube (CRT) – It is the major important block of CRO and mainly consists of four parts. Those are electron gun, vertical deflection plates, horizontal deflection plates and fluorescent screen. The electron beam, which is produced by an electron gun gets deflected in both vertical and horizontal directions by a pair of vertical deflection plates and a pair of horizontal deflection plates respectively. Finally, the deflected beam will appear as a spot on the fluorescent screen. In this way, CRO will display the applied input signal on the screen of CRT. So, we can analyse the signals in time domain by using CRO.

### **Measurement of frequency-**

- The signal whose frequency is to be measured is applied to the 'y' plate standard variable frequency source. It is used to supply voltage to 'X' plate with the internal sweep generator off. The standard frequency is adjusted until the pattern appears as a circle or as an ellipse indicating that both signals are of same frequency.

## **POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER**

**Q1. What is transducer ? Give it's application. [W-16,19,20, S-17]**

Ans. A transducer can be defined as a device which converts a non-electrical quantity into an electrical quantity.

Application- Piezoelectric transducer ,LVDT.

**Q2. What is Transducer. Classify different types of transducer.[W-18,19,S-19]**

Ans. A transducer is a device which converts the energy from one form to another form that is mechanical force to electrical energy.

Different type of Transducer are:

- i. Resistive transducer.
- ii. Inductive transducer.
- iii. Capacitive transducer.
- iv. Primary & secondary transducer.
- v. Passive and active transducer

**Q3. What is CRO?**

Ans. CRO is an extremely useful and most valuable laboratory instrument used for studying the shape of AC & DC voltage.

**Q4. What is Passive transducer? Give an example?**

Ans. Passive transducers are also known as externally powered transducer. In this transducer, the power required for the energy conversion takes from an external source.

Ex- Hall effect generator

## **POSSIBLE LONG TYPE QUESTIONS**

Q1. What is multimeter and write the difference between analog & digital multimeter? [W-17]

Q2- Describe Working principle of multimeter with basic block diagram ? [W-17,18]

Q3. Draw and explain the block diagram of CRO and also state its application [W-18,19,21,22]