BASIC ELECTRONICS

[BET-102]

2ND SEM ELEC/ETC/COMP ENGG.

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CHAPTER – 1
ELECTRONIC DEVICES

Q-1) Define Electronics. State its applications.

[W-13, Q1-a], [W-14, Q1-a], [S-16BP,Q1-a], [W-17,Q1-a], [W-17 BP,Q1-a],[2018 (W)],[2019 (W)]

Ans:-

The branch of engineering which deals with current conduction through vacuum or gas or semiconductor is known as electronics. The application of electronics can be found in communication & entertainment, industries, defense, medical science, automobiles & digital electronics, etc.

Q-2) Define & state the uses of IC.[W -14, Q2-a], [S -14, Q1-a], [W -15, Q1-a], [W-17,Q1-c],[2018 (W)]

Ans:-

Integrated Circuit (IC) is one in which circuit components such as transistors, diodes, resistors, capacitors, etc are automatically part of a small semiconductor chip.

It has large number of applications. Some of the very important uses are –

In solid state transistor radio sets, TV sets as audio and RF amplifiers.

- In digital electronic devices like, clocks, calculators, measuring instruments, video games etc.
- In computers and control circuits, etc.

Q-3) What is Free and Valence Electrons? [S-16,Q1-a]

Ans:-

The valence electrons which are very loosely attached to the nucleus are known as free electrons.

The electrons in the outermost orbit of an atom are known as valence electrons.

Q-4)Define Forbidden Energy gap & Work function of a metal? [S-16, Q2-a], [W-17 BP,Q2-a],[2019 (W)]

Ans:-

The separation or gap between conduction band and valance band on the energy level diagram is known as forbidden energy gap.

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

Q-5) What do you mean by doping? Give two examples of impurities. Write its need.
[W-13, Q2-a],* [S-15, Q6-a], *[S-16BP, Q2-a], [S -16, Q7-a], [W-17,Q1-d],[2018 (W)]
Ans:-

The process of adding some suitable impurities to pure semiconductor is known as doping. Two impurities are arsenic (As) and gallium (Ga). Doping is needed to increase the current conductivity of the semiconductor.

Q-6) What is knee voltage and break down voltage?
[S-15, Q3-a], [S-16, Q4-a]
Ans:-

The forward voltage at which the current through the junction starts to increase rapidly is known as knee voltage.

The minimum reverse voltage at which pn-junction breaks down with sudden rise in reverse current is called breakdown voltage. It is of two types- avalanche breakdown &zener breakdown.

***Q-7) State the basic function of zener diode.* [S-14, Q2-a]**
Ans:-

A properly doped crystal diode which has a sharp breakdown voltage is known as a zener diode. The basic function of zener diode is to be operated in the breakdown region to have a relatively constant voltage across it, regardless of the value of current through the device during reverse bias. A zener diode is predominantly used as a voltage regulator.

***Q-8) Specify some of the characteristics of semiconductor diode.* [S-15, Q7-a]**
Ans:-

A pn-junction is known as a semiconductor diode. The outstanding property of this diode is to conduct current in one direction only. The forward

resistance of the diode is very small (1 to 25Ω) and the reverse resistance is infinite.

Q-9) Define depletion region. **[S-13, Q2-c]**

Ans:-

When the pn-junction is formed, the n-region loses some free electrons creates a +ve layer during diffusion while the p-region loses some of holes as the electrons and holes combine & create a –ve layer. These two layers of +ve& -ve charges forms the depletion layer or region.

Q-10) Define Electron Emission. Discuss the types of Electron Emission. [S-16,Q1-b] , [S-16BP,Q1-b], [S-15, Q1-c], [W -15, Q5-a], [W-17,Q-3], [W-17 BP,Q2-c], [S-19,Q1-g],[2018 (W)],[2019 (W)]

Ans:-

The liberation of electrons from the surface of a substance is known as electron emission. It is of four types – (i) Thermionic emission (ii) Field emission (iii) Photo-electric emission and (iv) Secondary emission.

- ***Thermionic Emission:-*** In this method, the metal is heated to sufficient temperature (about 2500C) 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.

- ***Field Emission:-*** In this method, a strong electric field (high +ve voltage) is applied at the metal surface which pulls the free electrons out of metal because of the attraction of +ve field. The stronger the electric field, the greater is the electron emission.

- ***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(brightness) of light beam falling on the metal surface, the greater is the photo-electric emission.

- ***Secondary emission:-*** In this method, a high velocity beam of electrons strikes the metal surface and causes the free electrons of the metal to be knocked out from the surface. The emitted electrons are called secondary electrons.

Q-11) What is Intrinsic & Extrinsic semiconductor? Discuss one type of Extrinsic semiconductor. [S-16, Q2-b],[2018 (W)]

Ans:-

A semiconductor in an extremely pure form is known as intrinsic semiconductor and a semiconductor formed by adding some suitable amount of impurity is known as extrinsic semiconductor. Depending upon the type of impurity added, extrinsic semiconductors are two types – (i) n-type semiconductor (ii) p-type semiconductor.

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 like Arsenic & Antimony provides a large number of free electrons in the semiconductor crystal. The four valence electrons of the pentavalent impurity atom form covalent bonds with four neighboring semiconductor atoms. The fifth left over valence electron of the impurity atom cannot accommodated in the valence band and travels to the conduction band. The current conduction in an n-type semiconductor is predominantly by the free electrons or –ve charges.

Q-12) Differentiate between intrinsic semiconductor and extrinsic semiconductor.

[W-19,Q2-d]

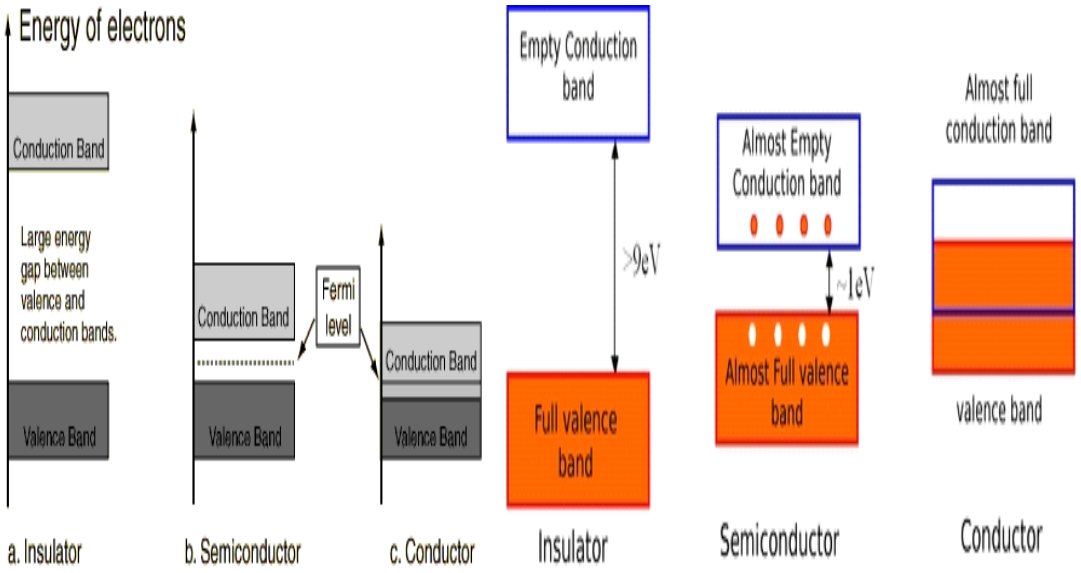
ANS:-

Parameter	Intrinsic Semiconductor	Extrinsic Semiconductor
Form of semiconductor	Pure form of semiconductor.	Impure form of semiconductor.
Conductivity	It exhibits poor conductivity.	It possesses comparatively better conductivity than intrinsic semiconductor.
Band gap	The band gap between conduction and valence band is small.	The energy gap is higher than intrinsic semiconductor.
Fermi level	It is present in the middle of forbidden energy gap.	The presence of fermi level varies according to the type of extrinsic semiconductor.
Dependency	The conduction relies on temperature.	The conduction depends on the concentration of doped impurity and temperature.
Carrier concentration	Equal amount of electron and holes are present in	The majority presence of electrons and holes depends on

	conduction and valence band.	the type of extrinsic semiconductor.
Type	It is not further classified.	It is classified as p type and n type semiconductor.
Example	Si, Ge etc.	GaAs, GaP etc.

Q-13) Classify solids with respect to energy band diagram.
[W-13,Q1-c], [W-14,Q1-c], [S -14, Q1-b], [W-15,Q1-b], [S-15, Q2-c], [S-16, Q1-c], [S-16BP, Q1-c]
[W-17,Q2-a], [W-17 BP,Q1-c],[2018 (W)]
Ans:-

Solids are classified as Insulators, Conductors and Semiconductors. The difference in the behavior of solids as regards their electrical conductivity can be explained by energy bands.



Insulators:- Insulators are those substances which do not allow the passage of electric current through them. Ex- Wood, Glass, Plastic, etc. In term of the energy band, the valence band is full while the conduction band is empty. Further, the forbidden energy gap is very large (15eV). Therefore, the valence electrons cannot be pushed to the conduction band.

Conductors:- Conductors are those substances which easily allow the passage of electric current through them. Ex- Copper, Aluminum, etc. There is large amount of free electrons are available in conduction band. The valence

band and conduction band overlap each other. Due to this overlapping, a slight potential difference across a conductor causes the free electrons to constitute electric current.

Semiconductors:- Semiconductors are those substances whose electrical conductivity lies in between conductors & insulators. The valence band is almost filled and the conduction band is nearly empty. Further, the energy gap between V.B. and C.B. is very small (1eV). Therefore, comparatively smaller electric field is required to push the electrons from V.B. to C.B. The semiconductor behaves as insulator at low temperature and as conductors at high temperature. The semiconductor has –ve temperature co-efficient of resistance.

Q-14) Compare between vacuum tube and semiconductor.
[W-13,Q2-b] , [W-14,Q1-b], [S-14, Q1-c]

Ans:-

VACCUM TUBE	SEMICONDUCTOR
• Current conducted through vaccum. • Requires heating element. • Very large in size. • Consumes large power. • Heavy in weight. • High operating voltage is required. • Handle large current and high inverse voltage. • Brittle in construction.	• Current conducted through semiconductor. • No heating element required. • Small in size. • Consume less power. • Light in weight. • Low operating voltage is required. • Handle low current and low inverse voltage. • Fragile in construction.

Q-15) Write short notes on IC. [W-13,Q1-b] , [S-16BP, Q2-c-ii],

[W-17,Q1-c]

Ans:-

An integrated circuit (IC) is one in which, ckt. components such as transistors, diodes, resistors, capacitors, etc are automatically part of a small semiconductor chip.

Various components are the part of the chip whose interconnections in the chip perform a complete electronic function and the individual components cannot be removed or replaced. These components are formed and connected within a small chip of semiconductor material. No components of an IC are seen to project above the surface of the chip. It is extremely small in size, lesser in weight and has increased reliability.

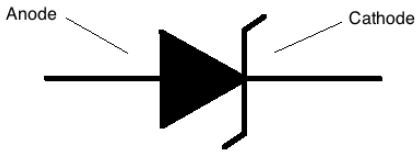
IC has a wide application in the area of digital electronics such as- Radio receiver, TV, Mobile phone, Digital watches & clocks, Calculators, Computer ckt, Digital meters etc.

Q-16) Explain construction, symbol & working operation of zener diode with V-I curve.

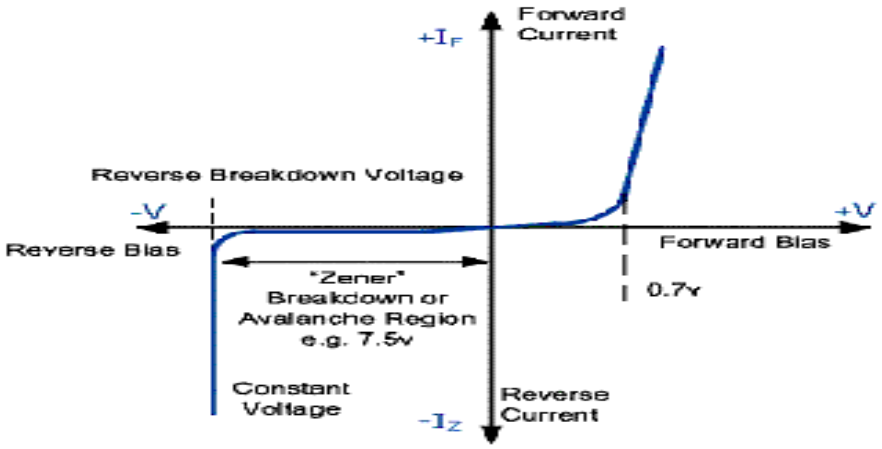
[W-13, Q2-c], [W-14, Q2-c], [W-19,Q6-b],*[2019 (W)]*

Ans:-

A properly crystal diode which has a sharp breakdown voltage is known as a zener diode. Symbol of Zener diode is



A zener diode is heavily doped to reduce the reverse breakdown voltage. The depletion region formed in the diode is very thin (<1μm). As a result the zener diode has a sharp breakdown voltage V_z.



In forward bias, the zener diode behaves just as a simple semiconductor diode.

When V_z is reached, the diode current increases rapidly and the reverse voltage V_z across the diode remains almost constant even though the current through it changes. Zener diode is not immediately burnt just because it has entered the breakdown region.

Q-17) Explain PN junction barrier voltage & junction capacitance.
[S-14, Q2-b], [S-19,Q2-e]

Ans:-

PN junction barrier voltage(V_b) :- When a pn-junction is formed, holes from p-type and free electrons from n-type diffuse, where they combine with each other. The diffusion current delays exponentially and due to the departure of free and mobile carriers form both side of the junction, a depletion layer if formed. This layer contains only immobile or fixed ions of opposite polarity. These uncovered fixed ions set up a potential barrier across the junction called junction barrier voltage V_b. This barrier voltage opposes further diffusion of charge carriers from one side to other.

Junction capacitance:- When a pn-junction is reverse biased, the depletion region acts like an insulator or as a dielectric material. The p-type and n-type regions on either side have low resistance and acts as the plates

which is essential for making a capacitor. Hence the PN-junction acts as a parallel plate capacitor. This is called junction capacitance.

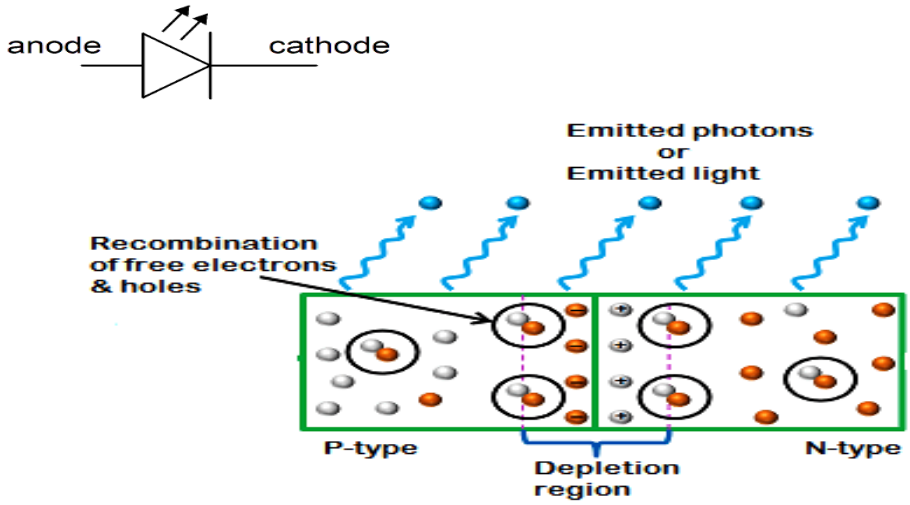
In reverse biasing, the junction capacitance is called transition or space charge capacitance (C_p) and in forward biasing, it is known as diffusion capacitance for the time delay in moving charge carriers.

Q-18) Write short notes on LED.

[S-14, Q2-c], [W-14, Q3-b], [S-15, Q1-b]. [S-15, Q7-b], [S-16BP, Q2-c i], [S-16, Q5-b], [S-16, Q7-c], *[W-17 BP,Q3-c],[2018 (W)],[2019 (W)]*

Ans:-

***LED*:-** A light emitting diode is a diode that gives off visible light when forward biased. LEDs are not made from S_i or G_e but are made by elements like gallium, phosphorous and arsenic.



When 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 energy in the form of heat and light.

As the LED is made from transparent materials such as Ga, As & P, the energy radiated in the form of light. The more the current flows through the junction, the intensity of light will be more.

LEDs are used as power indicator, seven segment display, in decorative items, in TV display, in digital clocks, calculators, etc.

Q-19) What is biasing? Explain the forward and reverse bias condition of pn-junction. [W-14, Q2-b], **[S-15, Q3-c],*[2018 (W)],[2019 (W)]***

Ans:-

Biasing is the method to the use of d.c. voltage to establish certain operating conditions of an electronic device. Biasing of pn-junction is of two types – Forward bias and Reverse bias.

FORWARD BIASING:- When external d.c. voltage applied to the junction is in such a direction that it cancels the potential barrier, thus permitting current flow, it is called forward biasing. To apply forward bias, +ve terminal of battery is connected with P-type and –ve terminal is with n-type. The applied forward potential establishes an electric field which acts against the field due to potential barrier. So, the resultant field is weakened and the barrier height is reduced at the junction and current starts conducting.

REVERSE BIASING:- When external d.c. voltage applied to the junction is in such a direction that potential barrier is increased, it is called reverse biasing. To apply forward bias, -ve terminal of battery is connected with P-type and +ve terminal is with n-type. The applied reverse voltage establishes an electric field which acts in the same direction as the field due to potential barrier. So, the resultant field is strengthenedd and the barrier height is increased at the junction and it prevents current flow across the junction.

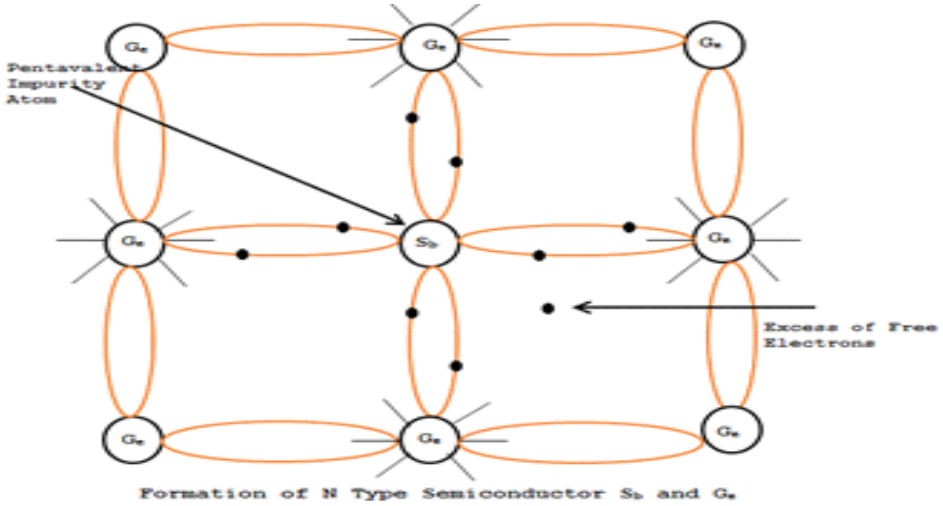
Q-20) What is Intrinsic & Extrinsic semiconductor? Discuss one type of Extrinsic semiconductor. **[S-16, Q2-b], [S-15, Q5-b],** ***[W-17 BP,Q6-b],[2018 (W)]***

Ans:-

A semiconductor in an extremely pure form is known as an intrinsic semiconductor and a doped semiconductor or impure semiconductor is call extrinsic semiconductor. Some suitable amount of impurity is introduced into the pure semiconductor to increase its conductivity which

forms extrinsic semiconductor. Extrinsic semiconductor is of two types – P-type semiconductor & N-type semiconductor.

N-type semiconductor:- When a small amount of pentavalent impurity is added to a pure semiconductor, it is known as n-type semiconductor.



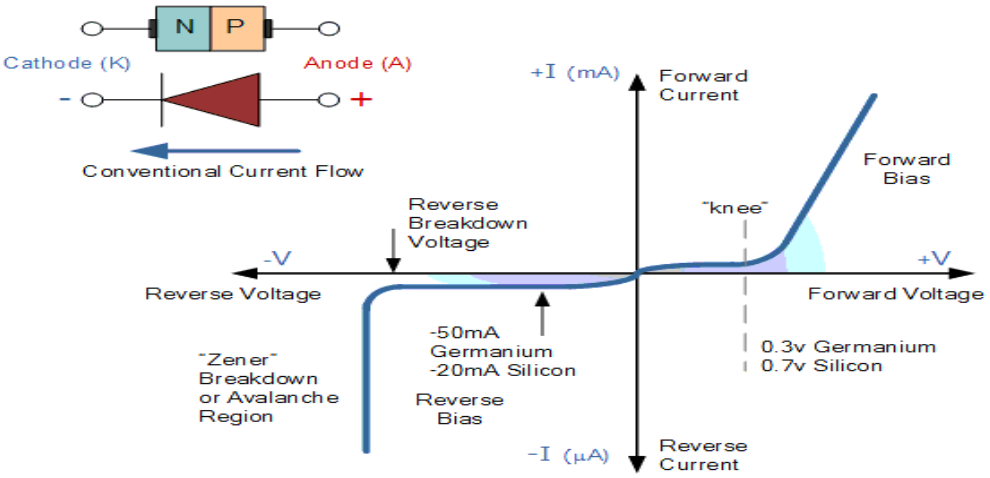
Formation of N Type Semiconductor S_b and G_e

The addition of pentavalent impurity like antimony, arsenic provides a large number of free electrons in the semiconductor. As four electrons form covalent bonds leaving the fifth valence electron unbonded. Thus each impurity atom added, one free electron will be available in the crystal. An extremely small amount of antimony impurity provides enough atoms to supply millions of free electrons. The current conduction in an n-type semiconductor is predominantly by free electrons.

Q-21) Describe the V-I characteristic of PN junction. **[S-16, Q2-c],** ***[W-17 BP,Q4-b],[2018 (W)],[2019 (W)]***

Ans:-

Volt-ampere or V-I characteristic of a pn-junction is the curve between voltage across the junction and the circuit current. Usually, voltage is taken along X-axis and current along Y-axis.



The characteristics can be determined under 3 categories—

- ***Zero external voltage***:- When the external voltage is zero (i.e) ckt. is open, the potential barrier at the junction does not permit current flow. Therefore, ckt. current is zero.
- ***Forward bias***:- With forward bias to the pn-junction, the potential barrier is reduced. At some forward voltage in the ckt, the potential barrier is altogether eliminated and current starts flowing in the circuit. From now onwards, the current increases with the increase in forward voltage. This voltage is called knee voltage of the junction. Thus the curve is almost linear.
- ***Reverse bias***:- With reverse bias to the pn-junction, the potential barrier at the junction is increased. Hence, the junction resistance becomes very high and no current flows through the circuit. However, a small current flows in the ckt. which is called reverse saturation current (I_s) and is due to minority carriers.

If reverse voltage is increased continuously, the kinetic energy of the minority carriers may become high enough to knock out electrons from the semiconductor atoms. At this stage break down occurs by a sudden rise in reverse current and a sudden fall of the resistance of the barrier region. This may destroy the junction permanently. This voltage is called break down voltage.

Q-22)Define reversed saturation current of a junction diode.2019w

Reverse saturation current is the limiting current through an ionized gas or an electron tube such that further increase of voltage produces no further increase in current.

Q-23)Define avalanche and Zener breakdown.2019w

CHAPTER – 2
ELECTRONIC CIRCUITS

Q-1) What do you mean by Filter and names of different types of filter? [W-13, Q4-a],[2018 (W)],[2019 (W)]

Ans:-

A filter circuit is a device which removes the a.c. component of rectifier output but allows the d.c. component to reach the load.

Different types of filter circuit are – (i) Capacitor filter, (ii) Choke input filter and (iii) Capacitor input filter or Π-filter.

Q-2) Define rectifier & Name its types. What is the need of rectifier? [S-14, Q3-a], [W-14, Q3-a], [S-16BP, Q3-a],[2018 (W)],[2019 (W)]

Ans:-

A rectifier is an electronic circuit or device which converts a.c. power into d.c. power with very efficiency. It is of 3 types—(i) Half wave rectifier,
(ii) Center tap full wave rectifier and (iii) Bridge full wave rectifier. Rectifier is needed to supply dc power which can be used for charging storage batteries, field supply of dc generators, electroplating, etc.

Q-3) What is the need of filter circuits? [S-15, Q2-a],[2018 (W)][2019w]

Ans:-

A filter circuit is needed to remove the ac component from the pulsating output of the rectifier and allows only the dc component to reach the load. It converts pulsating dc into pure dc.

Q-4) Define PIV. [S-15, Q2-a], [S-16, Q3-a], [W-17,Q1-b], [W-17 BP,Q3-a],[2019 (W)]

Ans:-

PIV or peak inverse voltage is the maximum reverse voltage that a diode can withstand without destroying the junction.

Q-5) What is efficiency? Write down the efficiency of Half wave and Full wave rectifier. [S-15, Q4-a]

Ans:-

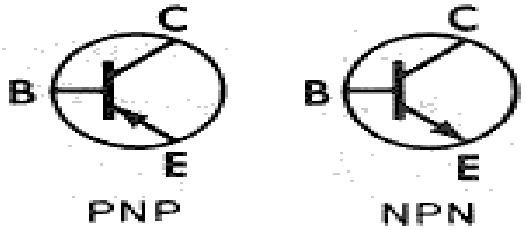
The ratio of dc power output to the applied input ac power is known as rectifier efficiency (i.e) Rectifier efficiency, =

The efficiency of half-wave rectifier is 40.6% and of full-wave rectifier is 81.2%

Q-6) List the different types of transistors and draw its symbol. [W-13, Q3-a], [S-16, Q5-a], [S-16BP, Q4-a],[2018 (W)]

Ans:-

Transistors are two types – (i) N-P-N transistor and (ii) P-N-P transistor



Q-7) State the transistor parameters. [S-14, Q4-a],[2018 (W)]

Ans:-

Parameter	Definition and description
I_{EBO}	Emitter base cut-off current
h_{FE}	Forward current gain
V_{CEsat}	Collector emitter saturation voltage
V_{BEsat}	Base emitter saturation voltage

Q-8) State the definition of Transistor. [W-14, Q5-a], [W-17,Q1-g],[2018 (W)]

Ans:-

Transistor is a 3 terminal electronic device consists of two pn-junctions formed by sandwiching either p-type or n-type semiconductor between a pair of opposite type.

Q-9) Define Q-point. Why it is necessary for stabilization? [W-15, Q4-a],[W-17 BP,Q4-a][2019w]

Ans:-

The zero signal values of I_C and V_{CE} are known as the operating point or quiescent point or Q-point.

It is needed for stabilization because of temperature dependence of I_C, individual variations and thermal runway.

Q-10) What is transistor biasing and what are the different methods of biasing?
[W-15, Q4-a], [W-17 BP,Q5-a], [S-19,Q1-i],[2018 (W)]

Ans:- The proper flow of zero signal collector current and the maintenance of proper collector-emitter voltage during the passage of signal is known as transistor biasing. Biasing is needed to achieve the faithful amplification. The different types of biasing are –

- Base resistor bias
- Emitter bias bias
- Collector –feedback resistor bias
- Voltage- divider bias

Q-11) Explain ripple factor, PIV and TUF of diode. [S-14, Q3-b], [W-17,Q1-e],[2018 (W)][2019w]

Ans:-

Ripple factor:- The output current of a rectifier contains dc as well as ac component. The undesired ac component has a frequency of 100Hz and is called ripple. The ratio of r.m.s. value of ac component to the dc component in the rectifier output is known as ripple factor

(i.e) Ripple factor = =

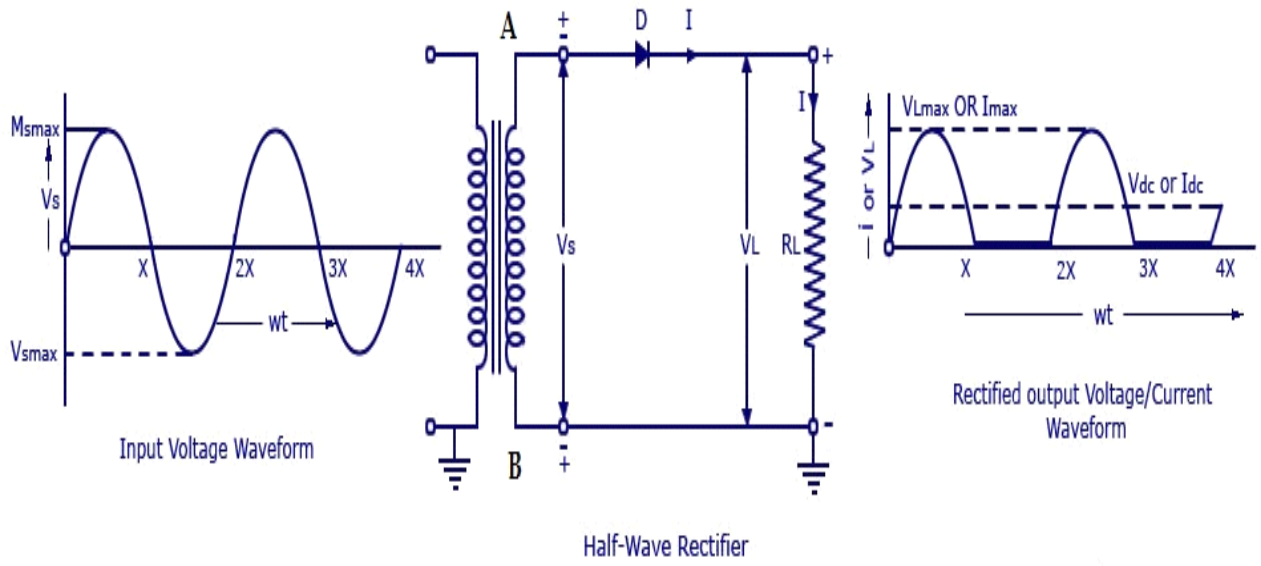
PIV:- Peak inverse voltage is the maximum reverse voltage that a diode can withstand without destroying the junction. If the reverse voltage across the diode exceeds this value, the reverse current increases sharply and breaks down the junction due to excessive heat.

TUF:- Transformer utilization factor is the ratio of output voltage of the rectifier to the input voltage (dc). For step down, TUF <1 and for step up, TUF >1.

Q-12) Explain the working principle of Half wave rectifier and its merits. [W-13, Q3-b], [W-17,Q-4]

Ans:-

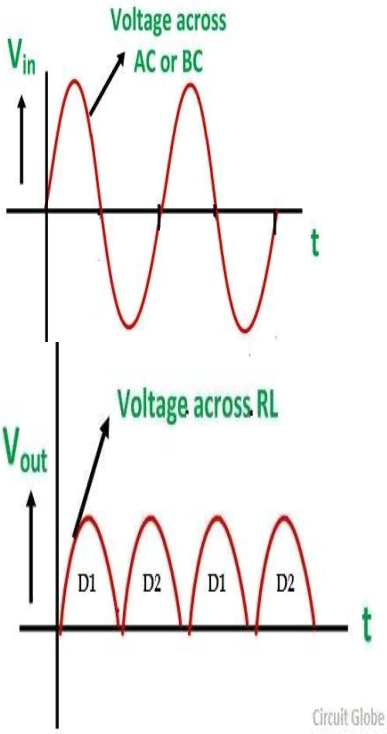
In half wave rectification, the diode conducts current only during the +ve half cycles of i/p ac supply. No current conducted or suppressed during –ve half cycles. Therefore, current always flow in one direction (dc) through the load resistor after every half cycle.

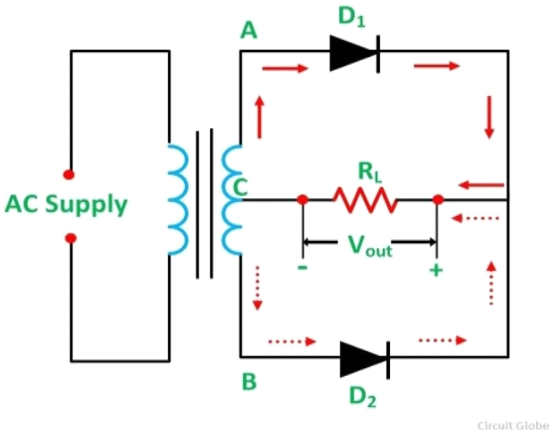


When the ac voltage across the secondary winding AB changes polarities for every alternative cycles, the end A becomes +ve w.r.t. end B during the +ve half cycle of the ac voltage (Vin). This makes the diode forward biased and hence it conducts current. During –ve half cycle, end A becomes –ve w.r.t. end B which makes the diode reverse biased and it conducts no current. Therefore, current flows through the diode to the load during +ve half cycle of ac voltage and is blocked during the –ve half cycle. Hence, current flows through the load R_L always in the same direction. So, the dc is obtained across R_L.

Q-13) Describe the working of centre tapped full wave rectifier. [S-14, Q3-c], [W-14, Q3-c][2019w]

Ans:-





In a centre tapped rectifier, a centre tap transformer with secondary winding AB tapped at the centre C is employed with two diodes D_1 and D_2 so that each one of them uses one half cycle of ac supply.

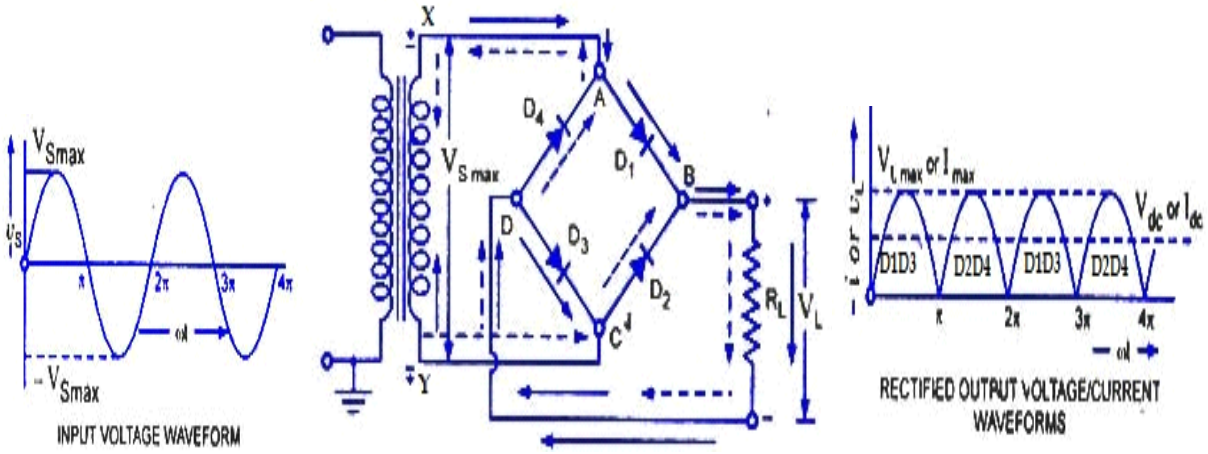
When ac supply is given to the ckt. an alternating voltage appears across AB secondary winding of transformer. During +ve half cycle at secondary voltage, the end A becomes +ve and end B is –ve. This makes diode D_1 conducts and D_2 does not. Thus, current flows through diode D, load RL and the upper half of the secondary.

During –ve half cycle, diode D_2 is forward biased and diode D_1 is reverse biased. Thus, diode D_2 conducts current and D_1 does not. Now, current flows through diode D_2, load R_L and the lower half of the secondary. In both cases, the conventional current flows through the load R_L in same direction. Therefore, the dc voltage is obtained across R_L ($V_{out} = iR_L$).

Q-14) Describe the working of Bridge full wave rectifier with its

advantages & disadvantages by neat diagram. [S-14, Q3-c], [W-14, Q3-c],
[W-15, Q3-b], [S-15, Q3-c], [S-16, Q3-c] [S-16BP, Q3-c], [W-17,Q-4], [W-17 BP,Q3-b],
[S-19,Q3-b],[2018 (W)],[2019 (W)]

Ans:-



A full wave bridge rectifier consists of an ordinary transformer with four diodes connected to form a bridge.

When ac supply is given, the alternating voltage appears at AB of the secondary of the transformer. During +ve half cycle of ac supply the end X becomes +ve w.r.t. end Y. This makes the diagonally diodes D_1& D_3 forward biased where D_2& D_4 reverse biased. Thus, the current flows through diode D_1, load R_L and diode D_3 while diode D_2& D_4 does not conduct current.

During –ve half cycle of ac supply, the end X becomes –ve and end Y is +ve. This makes diode D_2& D_4 forward biased while diode D_1& D_3 reverse biased. Thus, diode D_2& D_4 conducts where diode D_1& D_3 does not. Hence, current flows through diode D_2, load R_L and diode D_4.

The conventional current flows through the load in the same direction for both the half cycles of ac supply. Hence, the dc voltage V_{out} is obtained across the load R_L.

Advantages:-

- The need of centre-tapped transformer is eliminated.
- The output is twice that of centre tap circuit for the same secondary voltage.
- The PIV is one-half that of the centre-tap circuit for same dc output.

Disadvantages:-

- It requires four diodes.

- During each half cycles of ac, two diodes that conduct are in series. Thus, voltage drop in the internal resistance of the rectifying unit is twice as great as in the centre-tap circuit.

Q-15) Differentiate between different types of rectifiers.
[W-14, Q3-c], [W-15, Q7-c,i]

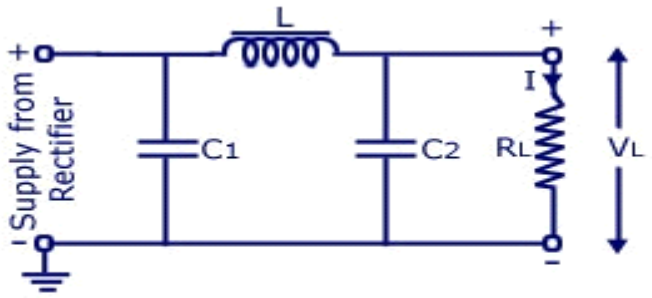
Ans:-

Particulars	**Half-wave**	**Centre-tap**	**Bridge type**
• No. of diodes used	1	2	4
• Centre tap transformer necessary	No	Yes	No
• Maximum efficiency	40.6%	81.2%	81.2%
• Ripple factor	1.21	0.48	0.48
• Output frequency	f_{in}	$2f_{in}$	$2f_{in}$
• PIV	V_m	$2V_m$	V_m

Q-16) Write down the types of Filter and explain the operation of capacitor i/p or
Π-filter. [S-15, Q2-b], [W-17,Q2-d], [W-17 BP,Q1-b],[2019 (W)]

Ans:-

Filter circuits are of 3-types, (i) Capacitor filter, (ii) choke i/p filter and (iii) Capacitor i/p or Π-filter.

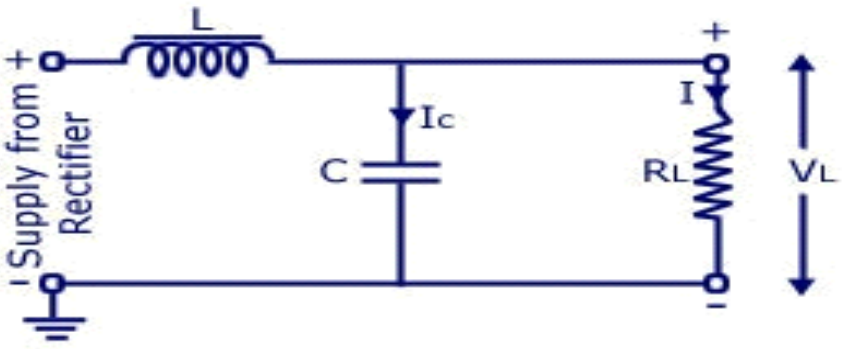


Circuit Digram

A Π-filter consists of a filter capacitor C_1 connected in parallel to rectifier , a choke L in series and another filter capacitor C_2 connected across the load. The pulsating dc output from the rectifier is applied across the input terminal of Π-filter.

- The filter capacitor C_1 offers low reactance to ac component of rectifier while it offers infinite reactance to the dc component. Therefore, capacitor C_1 bypasses an appreciable amount of ac component while the dc component continues to the choke L.
- The choke L offers high reactance to the ac component but it offers almost zero reactance to the dc component. Hence, it allows the dc component to flow through it, while the un-bypassed ac component is blocked.
- The filter capacitor C_2 bypasses the ac component which the choke has failed to block. So, only dc component appears across the load and that is the pure dc.

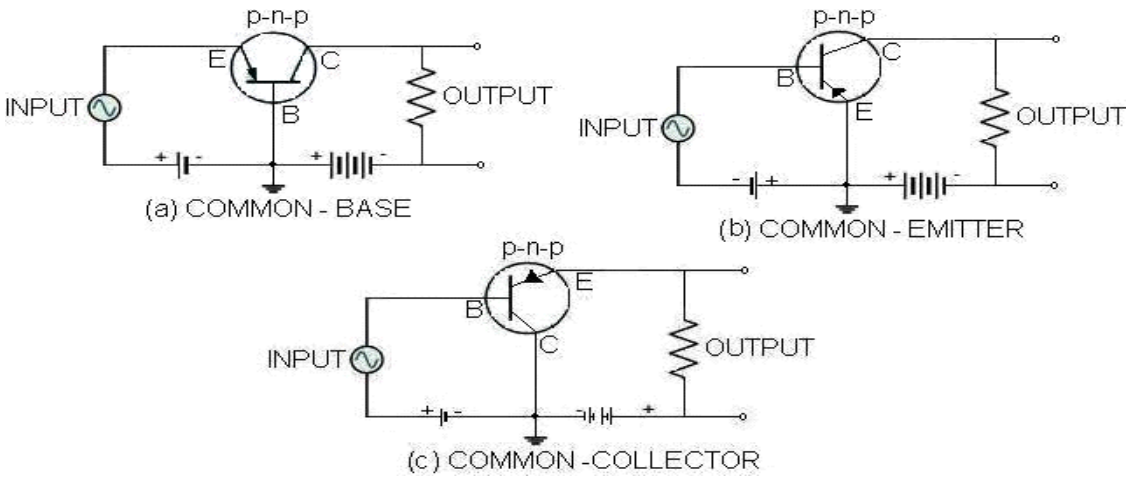
Q-17) Explain the operation of choke i/p filter. [S-16, Q3-b]
Ans:-



The choke input filter consists of a choke L connected in series with the rectifier and a filter capacitor C across the load. The pulsating of the rectifier is applied to the terminal 1 & 2. The choke offers high opposition to the passage of ac component but negligible opposition to the dc component. The result is that most of the ac component of the pulsating dc appears across the choke while whole of the dc component passes through it to the load. At terminal 3, the low reactance of filter capacitor bypasses the ac component but prevents the dc component to flow through it. Therefore, only the dc component reaches the load. This way the filter circuit has filtered out the ac component from the pulsating dc.

Q-18) Draw the different transistor amplifier configuration (CE, CB, CC). State the relation between , and (alpha, beta and gamma).
[W-13, Q4-b], [S-14, Q4-b], [W-14, Q5-b], [W-15, Q7-c_ii], [S-15, Q3-b], [S-16BP, Q4-b]
[W-17,Q2-c], [W-17,Q2-b], [W-17 BP,Q4-c],[2018 (W)],[2019 (W)]

Ans:-



Common Base Configuration:-

In this arrangement, is applied between base & emitter and is taken from collector & emitter. Here, emitter of the transistor is common to both & circuits. The amplification factor is = at constant V_{CB} which is less than unity (1). The collector current is $I_C = I_E + I_{CBO}$where, I_{CBO} is the leakage or collector-base current with emitter open. Voltage gain of this configuration is about 150.

Common Emitter Configuration:-

In this arrangement, is applied between emitter & base and is taken from collector & base. Here, emitter of the transistor is common to both & circuits. The amplification factor is = at constant V_{CE} which is greater than 20. The collector current is $I_C = I_B + I_{CEO}$where, I_{CEO} is the leakage or collector-emitter current with base open. Voltage gain of this configuration is about 500.

Common Collector Configuration:-

In this arrangement, is applied between base & collector and is taken from emitter & collector. Here, collector of the transistor is common to both & circuits. The amplification factor is = at constant V_{CE} which is greater than 20. The collector current is $I_C = (+1)I_B + (+1)I_{CBO}$. Though the current gain is equal to that of CE configuration, the voltage gain is less than 1.

The ratio of change in output current to the change in input current at constant output voltage is the amplification factor of the amplifier. The amplification factors are = , = and = for CB, CE & CC configuration of transistor respectively.

Relation between & :-

= …….. (i) and = ….. (ii)

=

Relation between & :-

= …….. (i) and = ….. (ii)

=

Hence, relation between , and will be—

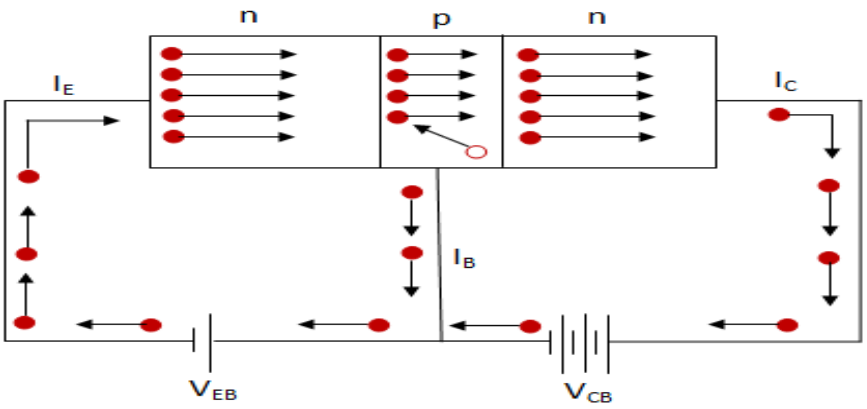
= or = 1 or =

Q-19) What is Transistor? Explain the operation of NPN Transistor with neat diagram. [S-15, Q4-b], [W-17,Q2-g], [W-17 BP,Q2-b]

Ans:-

Transistor is a 3 terminal electronic device consists of two pn-junctions formed by sandwiching either p-type or n-type semiconductor between a pair of opposite type.

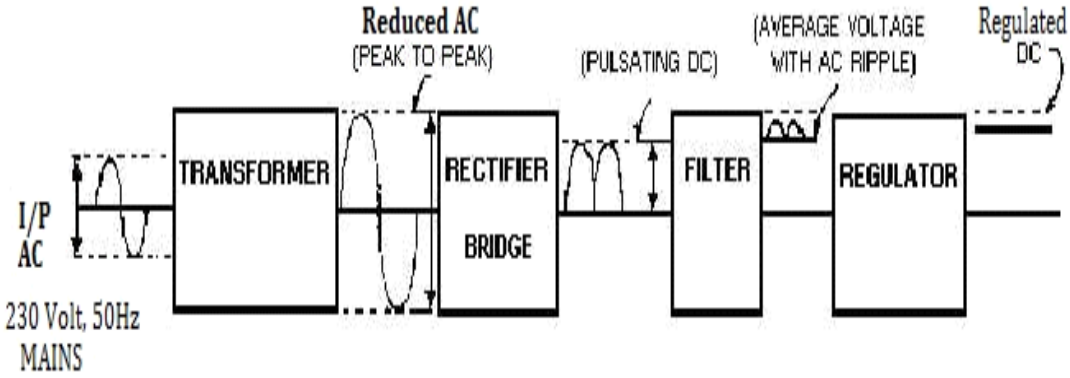
Operation of NPN transistor:-



The above figure shows the n-p-n transistor with forward bias to emitter-base junction and reverse bias to collector-base junction. The forward bias causes the electrons in the n-type emitter to flow towards the base. This constitutes the emitter current I_E. As these electrons flow through the p-type base, they tend to combine with holes. As the base is lightly doped and very thin, therefore, only a few electrons (<5%) combine with holes to constitute base current I_B. The remainder (more than 95%) cross over into the collector region to constitute collector current I_C. In this way, almost the entire emitter current flows in the collector circuit. It is clear that, $I_E = I_B + I_C$.

Q-20) Explain the DC power supply with the help of block diagram. Give a input signal and draw its wave form in each stage of block diagram. [W-13, Q3-c], [S-16BP, Q7-c], [W-17 BP,Q5-b]

Ans:-



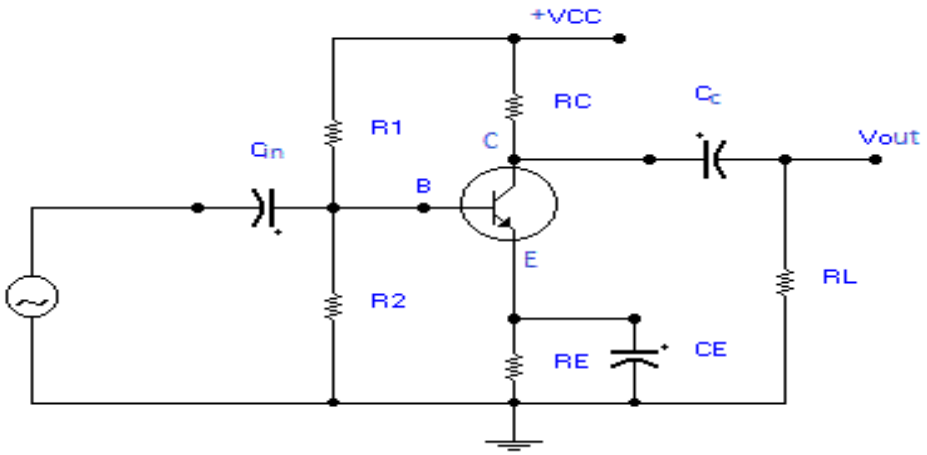
The block diagram of a regulated dc power supply and the wave form in each stage is shown in the above figure. The function of each block is as….

- ***Transformer:-*** Usually, dc voltage required for the operation of various electronic equipments is very low of 6V, 9V or 12V. This voltage is quite low to the i/p AC. Therefore, before rectification a step-down transformer is employed to decrease the voltage to the required level.
- ***Rectifier:-*** It converts ac into pulsating dc. The rectifier is generally a full wave bridge rectifier because of merits.
- ***Filter:-*** It removes the ripple from the output of the rectifier and smoothes it out. The dc o/p obtained from the filter is constant till the mains voltage and load is kept constant. However, if either of the two is varied, dc voltage received at this point changes. Hence, a regulator is employed at this stage.

Q-21) Explain single stage CE amplifier with voltage divider bias. Draw its equivalent circuit. [S-14, Q5-c], [W-15, Q5-c],[2019 (W)]
Ans:-

Single stage CE amplifier

When only one transistor with associated circuitry is used for amplifying a weak signal, the circuit is known as single stage transistor amplifier.



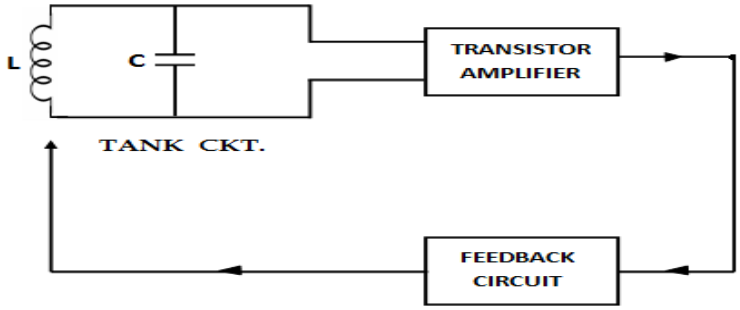
A simple single stage transistor amplifier contains one transistor and its associated biasing ckt. When a weak ac signal (V_{in}) is applied to the base of transistor, a small current (i_B, ac in nature) flows through it. This causes a much larger ac current through the collector (i.e) $i_C = \beta i_B$. As the value of R_C is quite high, a large output (V_{out}) is obtained across R_C. This is how a transistor amplifies a weak signal.

Q.22) Explain the essentials of Transistor oscillator with a neat circuit diagram.

[W-14, Q4-b], [S-15, Q6-b], [S-16, Q7-b], [W-17 BP,Q5-c],[2019 (W)]

Ans:-

The below figure shows the block diagram of a transistor oscillator.



Its essential components are tank circuit, transistor amplifier & feedback circuit.

Tank circuit:-

It consists of inductance coil (*L*) connected in parallel with capacitor (*C*). The frequency of oscillations in the circuit depends upon the values of inductance of the coil and capacitance of the capacitor.

Transistor amplifier :-

The transistor amplifier receives dc power from the battery and changes it into ac power for supplying to the tank circuit. The oscillations occurring in the tank circuit are applied to the input of the transistor amplifier. Because of the amplifying properties of the transistor, we get increased output of these oscillations. This amplified output of oscillations is due to the dc power supplied by the battery. The output of the transistor can be supplied to the tank circuit to meet the losses.

Feedbackcircuit:-

The feedback circuit supplies a part of collector energy to the tank circuit in correct phase to aid the oscillations (*i.e.*) it provides positive feedback.

CHAPTER – 3
COMMUNICATION SYSTEM

Q.1) What do you mean by Modulation & Demodulation?
[W-13, Q6-a], [W-14, Q6-a], [W-15, Q2-a], [S-16, Q6-a], [S-16BP, Q7-a], [W-17,Q1-f], [S-19,Q1-j],[2019 (W)]

Ans:-

The process of changing some characteristics (*amplitude, frequency or phase*) of a carrier wave in accordance with the intensity of the signal is known as modulation.

The process of recovering the audio signal from the modulated wave is known as demodulation or detection.

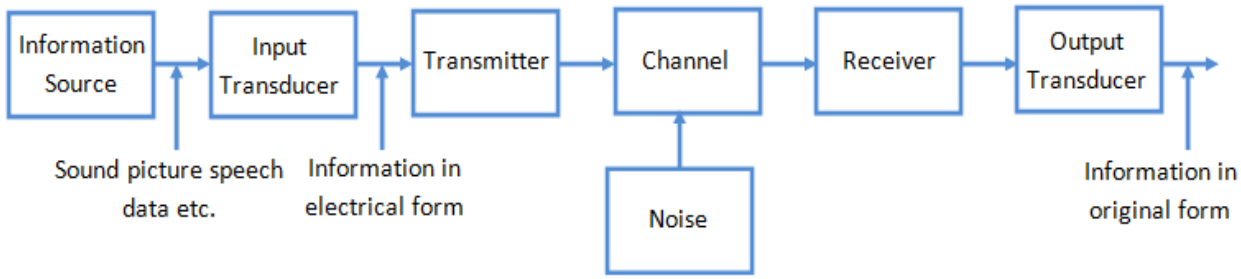
Q.2) Define Modulation and write down the type of Modulation. [S-15, Q5-a]

Ans:-

The process of changing some characteristics (*amplitude, frequency or phase*) of a carrier wave in accordance with the intensity of the signal is known as modulation. It is of three types – Amplitude modulation (AM);
Frequency modulation (FM) and
Phase modulation (PM)

Q.3) Explain the communication system with the help of block diagram. ,[2018 (W)]
[W-13, Q5-b]

Ans:-



The essential components of a communication system are information source, input transducer, transmitter, communication channel, receiver and destination..

Information Source:- A communication system serves to communicate a message or information. This information originates in the information source. The function of information source is to produce required message which has to be transmitted.

Input Transducer:- 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.

Transmitter:- The function of the transmitter is to process the electrical signal from different aspects.Modulation is the main function of the transmitter. In modulation, the message signal is superimposed upon the high-frequency carrier signal. Inside the transmitter, signal processings such as restriction of range of audio frequencies, amplification and modulation of are achieved.

Channel and Noise Source:- The term channel means the medium through which the message travels from the transmitter to the receiver. In other words, the function of the channel is to provide a physical connection between the transmitter and the receiver.

There are two types of channels, namely point-to-point channels and broadcast channels.During the process of transmission and reception the signal gets distorted due to noise introduced in the system.Noise is an unwanted signal which tends to interfere with the required signal. Noise may interfere with signal at any point in a communication system. However, the noise has its greatest effect on the signal in the channel.

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 demodulation or

detection. Demodulation is the reverse process of modulation carried out in transmitter.

Destination:- Destination is the final stage which is used to convert an electrical message signal into its original form.

Q.4) What are the need for modulation? Explain different types of modulation.

[W-13, Q5-c], [S-14, Q7-c], [W-14, Q6-b], [W-15, Q2-b],[S-15, Q4-c], [S-16, Q6-b], [S-16BP, Q7-b], [W-17,Q2-f], [W-17 BP,Q7-c], [S-19,Q7-b],[2018 (W)],[2019 (W)]

Ans:-

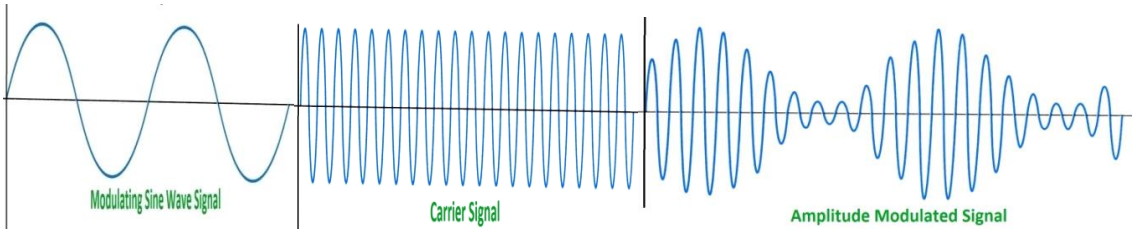
Modulation is extremely needed —

- To reduce the practical antenna length
- To increase the operating range
- To achieve wireless communication or radiate to space.

Different types of modulation are AM, FM & PM.

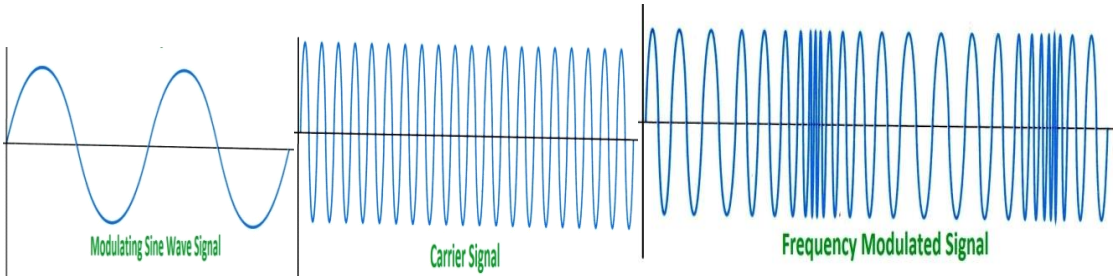
Amplitude modulation (AM):- When the amplitude of high frequency carrier wave is changed in accordance with the intensity of the signal, it is called amplitude modulation.

In AM, only the amplitude of the carrier is changed in accordance with the intensity of the signal but the frequency of the modulated wave remain constant (i.e.) of carrier wave.



Frequency modulation (FM):- When the frequency of carrier wave is changed in accordance with the intensity of the signal, it is called frequency modulation.

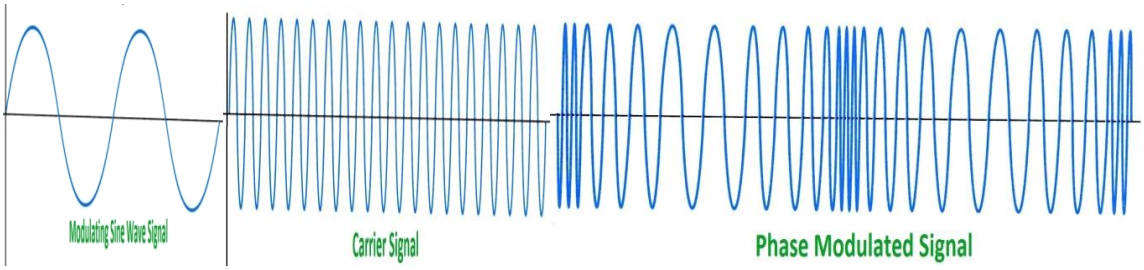
In FM, only the frequency of the carrier is changed in accordance with the intensity of the signal but the amplitude of the modulated wave remain constant (i.e.) of carrier wave.



The frequency variations of the carrier depend upon the instantaneous amplitude of the signal. When the voltage is zero, the carrier frequency is increased to maximum by closely spaced cycles. However, during –ve peaks of the signal; the carrier frequency is reduced to minimum by widely spaced cycles.

Phase modulation (PM):- The process by which phase angle of a carrier wave is varied in accordance with the modulating signal, it is called phase modulation.

In PM, the phase deviation is proportional to the amplitude of the modulating signal but is independent of its frequency. In this case the phasor of the modulated wave leads the reference position during +ve half cycle of the modulating signal. The angular displacement of the phasor of the modulated wave is restricted within the limits by the modulating signal.



CHAPTER – 4

TRANSDUCERS & MEASURING INSTRUEMENTS

Q.1) Write the application of multimeter. [W-13, Q7-a]

Ans:-

A multimeter is usually applied for ….

- Checking continuity of the circuit, lead, etc. ;
- Checking whether an electronic component is intact or not;
- Measuring d.c. voltage across various electronic components;

- Measuring a.c. voltage across transformer winding of the supply;
- Measuring small dc currents flowing through the cathode, plate, screen, etc. ;
- Measuring resistance of the circuit.

Q.2) Define Transducer. [S-14, Q7-a], [W-14, Q7-a], [W-17,Q1-i], [W-17 BP,Q6-a],[2018 (W)]2019w]

Ans:-

Transducer is an electronic device or circuit which converts any physical quantity into electrical signals.

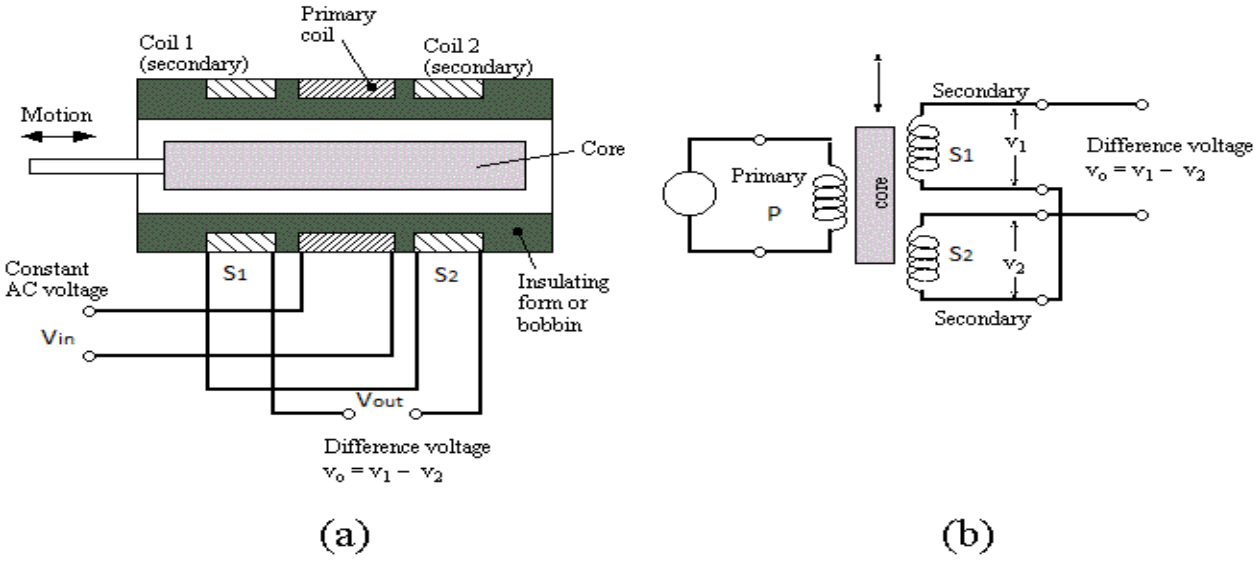
Q.3) Define SCR. [W-19,Q1-h]

Ans:-

Silicon Controlled Rectifier (SCR) is a solid state device used for power control in DC and AC system. An SCR is so called because silicon is used for its construction and its operation as a rectifier can be controlled.

Q.4) Describe the principle of LVDT with neat diagram. [W-13, Q6-c]

Ans:-



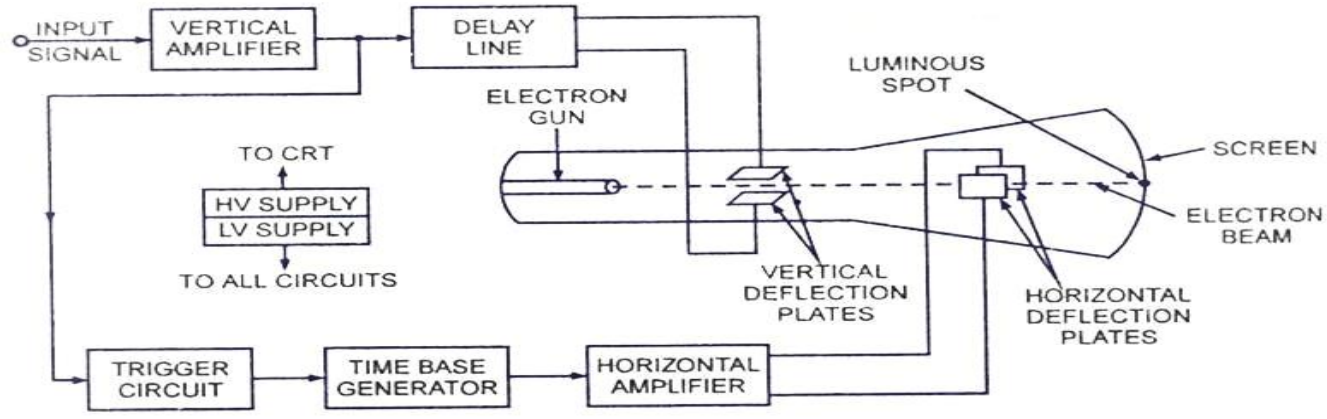
The primary winding (P) is given an AC supply of constant amplitude and ranging from 1 to 10kHz. This produces an alternating magnetic field in the center of the transducer as a result of which an induced voltage is set up in each of the secondary windings (S1 and S2) proportional to mutual inductance M of S coils with P coil. The value of M between P and S coils depends upon the position of the core.

As the core moves, M changes, causing the voltages induce in the secondaries to change. The induced e.m.f. in two secondary coils is in opposite phase and hence called “differential”. When the core is in its central position, equidistant between the two secondaries, equal but opposite voltages (V1 and V2) are induced in these coils, so the output voltage is zero.

When the core is displaced in one direction, the voltage in one coil increases as the other decreases, causing the o/p voltage to increase from zero to maximum. This voltage is in phase with primary voltage .When the core moves in the other direction, the o/p voltage also increases from zero to a maximum, but its phase is opposite to the distance moved by the core, that is why the device is described as linear.

Hence, the phase of the voltage indicates the direction of the displacement and magnitude of induced e.m.f. , finds the position.

Q.5) Draw and explain the block diagram of CRO with its application.
[W-13, Q7-b], [S-14, Q6-c], [W-15, Q5-b], [S-15, Q5-c], [S-16, Q6-c], [S-16BP, Q6-c],
[W-17,Q-5],[2019 (W)]
Ans:-



Vertical Amplifier:- The input signal is applied to vertical amplifier. The gain of this amplifier can be controlled by VOLT/DIV knob. Output of this amplifier is applied to the delay line.

Delay Line:- The delay Line retards the arrival of the input waveform at the vertical deflection plates until the trigger and time base circuits start the sweep of the beam. The delay line produces a delay of 0.25 microsecond so that the leading edge of the input waveform can be viewed even though it was used to trigger the sweep.

Trigger Circuit:- A sample of the input waveform is fed to a trigger circuit which produces a trigger pulse at some selected point on the input waveform. This trigger pulse is used to start the time base generator which then starts the horizontal sweep of CRT spot from left hand side of the screen.

Time Base Generator:- This produces a saw – tooth waveform that is used as horizontal deflection voltage of CRT. The rate of rise of positive going part of sawtooth waveform is controlled by TIME/DIV knob.

Horizontal Amplifier:- This amplifies the saw tooth voltage. As it includes a phase inverter two outputs are produced. Positive going sawtooth and negative going saw tooth are applied to right hand and left hand horizontal deflection plates of CRT.

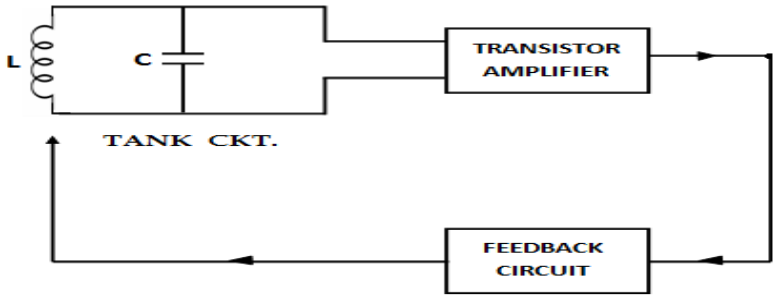
CRT:- It produces a sharply focused beam of electrons, accelerated to a very high velocity. This electron beam travels from electron gun to the screen. The electron gun consists of filament, cathode, control grid, accelerating anodes and focusing anode. While travelling to the screen, electron beams passes between a set of vertical deflecting plates and a set of horizontal deflection plates. Voltages applied to these plates can move the beam in vertical and horizontal plane respectively. The electron beam then strikes the fluorescent material (phosphor) deposited on the screen with sufficient energy to cause the screen to light up in a small spot.

Q.6) Explain the essentials of Transistor oscillator with a neat circuit diagram.

[W-14, Q4-b], [S-15, Q6-b], [S-16, Q7-b], [W-17 BP,Q5-c], [S-19,Q4-b],[2019 (W)]

Ans:-

The below figure shows the block diagram of a transistor oscillator.



Its essential components are tank circuit, transistor amplifier & feedback circuit.

Tank circuit:-

It consists of inductance coil (*L*) connected in parallel with capacitor (*C*). The frequency of oscillations in the circuit depends upon the values of inductance of the coil and capacitance of the capacitor.

Transistor amplifier :-

The transistor amplifier receives dc power from the battery and changes it into ac power for supplying to the tank circuit. The oscillations occurring in the tank circuit are applied to the input of the transistor amplifier. Because of the amplifying properties of the transistor, we get increased output of these oscillations. This amplified output of oscillations is due to the dc power supplied by the battery. The output of the transistor can be supplied to the tank circuit to meet the losses.

Feedbackcircuit:-

The feedback circuit supplies a part of collector energy to the tank circuit in correct phase to aid the oscillations (*i.e.*) it provides positive feedback.

Q.7) Explain working of multimeter and make a comparison between digital and analog multimeter. [S-14, Q7-b], [W-14, Q7-b], [W-15, Q4-c], [S-16BP, Q6-b],
[W-17,Q2-e], [W-17,Q-7],[2018 (W)],[2019 (W)]

Ans:-

A multimeter consists of an ordinary pivoted type of moving coil galvanometer. This galvanometer consists of a coil pivoted on jeweled bearings between the poles of a permanent magnet. The indicating needle is fastened to the coil. When electric current is passed through the coil, the mechanical force acts and the pointer moves over the scale indicating the measurement of the quantity which is always of left-zero type. To achieve the measurement of

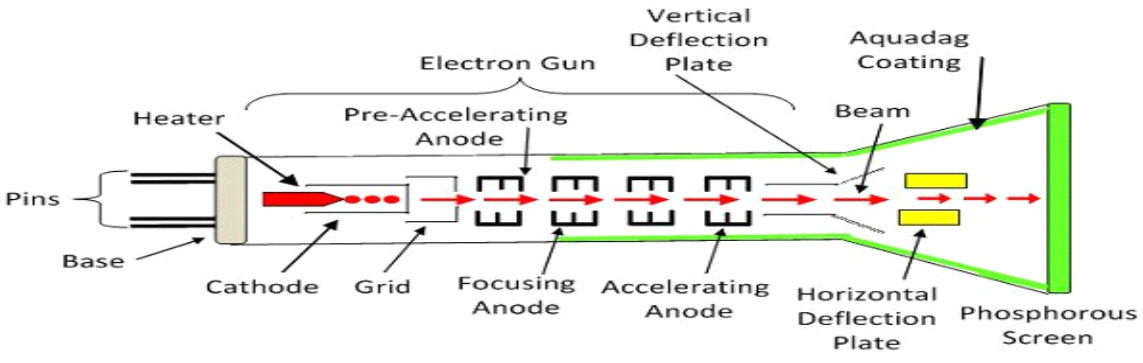
voltages, currents and resistances, proper circuits are incorporated with the galvanometer. Comparison between digital and analog multimeter is as ….

Aspects	AMM	DMM
• Power supply	Not required	Required
• Visual indication of changes in the reading	Better	Not that much
• Effect of electric noise	Less	More
• Isolation problems	Less	More
• Accuracy	Not possible	High
• Interface of the o/p with external equipment	Simple	Possible
• Construction	Bigger	Complex
• Size	Less	Smaller
• Cost	Ambiguous	More
• Nature of the output		Unambiguous

Q.8) Explain the construction and working of a cathode ray tube. [W-19, Q5-b],[2018 (W)]

Ans:-

The CRT is a display screen which produces images in the form of the videosignal. It is a type of vacuum tube which displays images when the electron beam through electron guns is strikes on the phosphorescent surface. The below figure shows the construction of a CRT.



WORKING:- The working of CRT depends on the movement of electrons beams. The electron guns generate sharply focused electrons which are accelerated at high voltage. This high-velocity electron beam when strikes on the fluorescent screen creates luminous spot. After exiting from the electron gun, the beam passes through the pairs of electrostatic deflection plate. These plates deflected the beams when the voltage applied across it. The one pair of plate moves the beam upward and the second pair of plate moves the beam from one side to another. The horizontal and vertical movement of the electron are independent of each other, and hence the electron beam positioned anywhere on the screen.The working parts of a CRT are enclosed in a vacuum glass envelope so that the emitted electron can easily move freely from one end of the tube to the other.

CONSTRUCTION:- The Electrons Gun Assembly, Deflection Plate Assembly, Fluorescent Screen, Glass Envelope, Base are the important parts of the CRT. The electron gun emits the electron beam, and through deflecting plates, it is strikes on the phosphorous screen.

The electron gun has a heater, cathode, grid, pre-accelerating anode, focusing anode and accelerating anode. The electrons are emitted from the highly emitted cathode. The electron which is emitted from the electron gun and passes through the control grid have high positive potential which is applied across the pre-accelerating and accelerating anodes. The beam is focused by focusing anode. After exiting the focusing anode, the beam passes through the vertical and horizontal deflecting plates. The deflection plate produces the uniform electrostatic field only in the one direction.

The front of the CRT is called the face plate. The face plate of the CRT is made up of entirely fibre optics which has special characteristics. The internal surface of the faceplate is coated with the phosphor. The phosphorous converts the electrical energy into light energy. The energy level of the phosphorous crystal raises when the electron beams strike on it. The Aquadag is the aqueous solution of graphite which is connected to the secondary of the anode. The Aquadag collects the secondary emitted electrons which are necessary for keeping the CRT screen in the state of electrical equilibrium.

Q.9) Differentiate between Sensor and Transducer.
[W-19, Q5-b]

Ans:-

Difference between Sensor and Transducer is as follows—

Aspect	Sensor	Transducer
Definition	Senses the physical	It is a device which, when

	changes occurs in the surrounding and converts it into a readable quantity.	actuates transforms the energy from one form to another.
Components	Sensor itself	Sensor and signal conditioning
Function	Detects the changes and induces the corresponding electrical signal.	Conversion of one form of energy to another.
Example	Proximity sensor, magnetic sensor, accelerometer sensor, light sensor, etc	Thermistor, Potentiometer, Thermocouple, LVDT, etc

Q.10) Define Resolution. [W-17 BP,Q6-a]

Ans:-

Resolution of a sensor is the smallest change it can detect in the quantity that is measuring.

Q.11) Write the characteristic of sensor. [W-17 BP,Q6-a]

Ans:-

A good sensor obeys the following rules –

- It is sensitive to the measured property.
- It is sensitive to any other property likely to be encountered in its application.
- It does not influence the measured property.

Q.12) Define Sensitivity. [W-17 BP,Q6-a]

Ans:-

Sensitivity is defined as the ratio between the o/p signal and measured property.

Q.13) Define Sensor & write it types. [W-17 BP,Q6-a]

Ans:-

A Sensor is a device, module, machine or subsystem whose purpose is to detect event or changes in its environment and send the information to other electronic ckt or processor. Generally, sensor gives an electrical signal or optical o/p.

Types of sensor:-

- Analog & Digital sensor
- Temperature sensor
- IR sensor
- Ultrasonic sensor
- Pressure sensor
- Proximity sensor
- Touch sensor
- Level sensor
- Smoke & Gas sensor