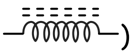
Elements of Electronics

Time : 3 Hrs.] Prelim Question Paper [**Marks : 100**

Instructions : (1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data, if necessary.
(5) Preferably, write the answers in sequential order.

Q.1 Attempt any TEN of the following : [20]

Q.1(a) Draw symbol of Ferrite core Inductors. Describe its construction and applications. [2]

(A) **Ferrite Core** : (Symbol )

(i) Construction : Same as that of air-core but the magnetic material used is ferrite, which has high mangetic permeability and high resistivty to eddy currents. Since μ_r is very high upto at 5000, therefore, values of inductance obtained are also high. Also the hystersis and eddy current losses are low as compared to iron-cored inductors.

(ii) Applications : For frequency range covering A.F. and R.F. upto 100 MHz. In transistor radio, ferrite rod antenna is used.

Q.1(b) List the passive filters used in field of electronics. [2]

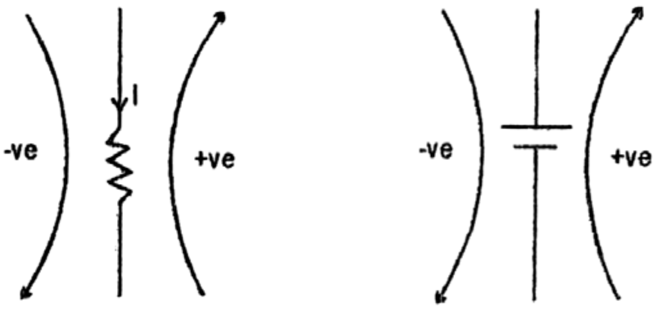
(A) Some of the passive filters used in the field of electronics are as given below :
(i) Series inductor (or choke) filters.
(ii) Shunt capacitor filter.
(iii) Choke input (LC or L type) filter.
(iv) Capacitor input (CLC or *n* type) filter.

Q.1(c) State the Kirchoffs Voltage Law along with its formula. [2]

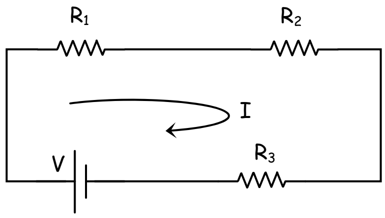
(A) **KVL** : It states that algebraic sum of voltage drops is equal to algebraic sum of voltage rises around a closed loop of a circuit, at any instant of time.

OR

It states that algebraic sum of voltages around a closed loop of a circuit is zero at any instant of time.
When II[nd] definition is used, we follow the convention that :
0000

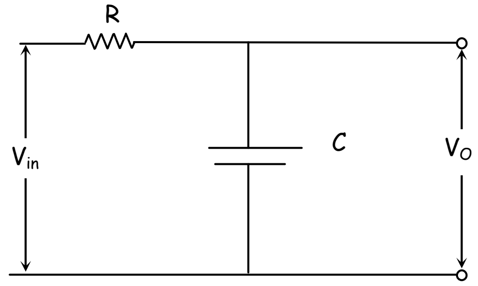


Formula : for the figure
$V = IR_1 + IR_2 + IR_3$



Q.1(d) State the condition for integration with reference to RC integrator with neat circuit diagram. [2]

(A)



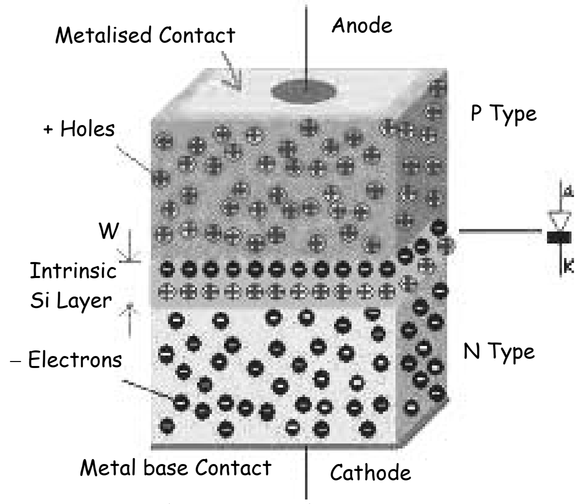
The condition for integration is,

$$V_0 = -\frac{1}{R_1 C_F}\int V_{in}\,dt$$

Q.1(e) Explain with neat sketch construction of PIN diode. [2]

(A) Construction of PIN diode

The PIN diode consists of a narrow layer of p-type semiconductor separated from an equally narrow layer of n-type material by a somewhat thicker region of intrinsic material. In fact, the intrinsic layer is a lightly doped n-type semiconductor. Although GaAs is used in the construction of PIN diodes, Si tends to be the main material. The reason for this is easier fabrication, higher powers handled and higher resistivity of intrinsic region. The PIN diode is used for microwave power switching, limiting and modulation.



PIN Diode Conceptual Construction

The construction of the PIN diode is as shown in Fig. 1. The advantage of the planar construction is the lower series resistance while conducting.

Encapsulation for such a chip takes any of the forms already shown for other microwave diodes. The in-line construction has a number of advantages, including reduced shunt capacitance. The construction shown in Fig. 1(c) is often preferred in practice, except perhaps for the highest powers. When fairly large dissipations arc involved, the planar construction is better adopted to mounting on a heat sink.

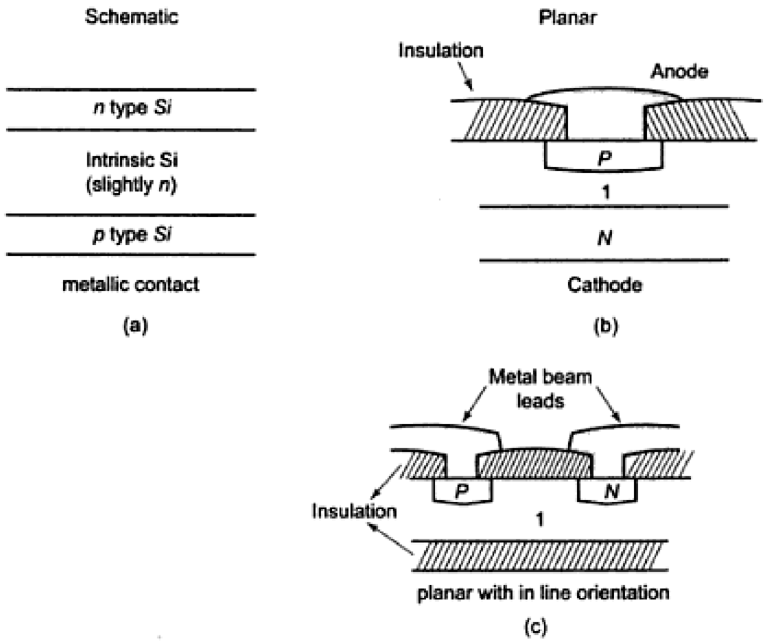


Fig. 1 : Construction of PIN diode

Q.1(f) Define ferromagnetic and ferrimagnetic material. Give on example of each. [2]

(A) **Ferromagnetic materials:** The materials which possess magnetism in the absence of applied magnetic field is known as ferromagnetic materials.
Example: iron, nickel, cobalt

Ferrimagnetic materials: They contain magnetic moments aligned antiparallel to one another, similar to antiferromagnetic materials. However, instead of having a zero net magnetic moment, different numbers of unpaired electrons in the component transition metals result do not cancel one another out, resulting in a spontaneous magnetization.
Example: Magnetite, Ferrous ferrite, Nickel ferrite, Manganese ferrite.

Q.1(g) State the necessity of rectifier and filter circuits. [2]

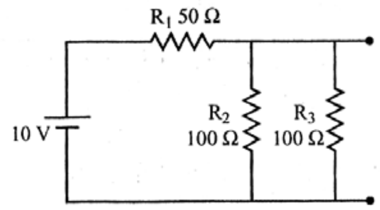
(A) **Need of Rectifiers:**

- Many electronic devices and circuits work on DC.
- It is then needed to convert A.C. into D.C.
- Rectifier is the best and cheapest way to provide D.C. for electronic devices.

Need of Filters:

- The output of a rectifier is pulsating D.C. [i.e. it contain A.C and D.C]. The A.C. components are undesirable and must be moved from the pulsating D.C. to obtain pure D.C. signal. To remove this filter circuit is used.

Q.1(h) Find current through resistor R_3. [2]



(A) **R_2 || R_3**

$$\frac{1}{R_{eq}} = \left[\frac{1}{R_2} + \frac{1}{R_3}\right] = \left[\frac{1}{100} + \frac{1}{100}\right]$$

$\therefore R_{eq} = 50\Omega$

R_1 in series with R_{eq}

$\therefore R_1 + R_{eq} = 50 + 50 = 100\ \Omega$

Total resistance $R_T = 100\ \Omega$, Voltage = 10V

$\therefore$ Total current (Through R_1) $= \frac{V}{R} = \frac{10V}{100R}$

$= 0.1A$

Total current (0.1A) from R_1 gets split into 2 branches R_2 and R_3

$\because R_2 = R_3$

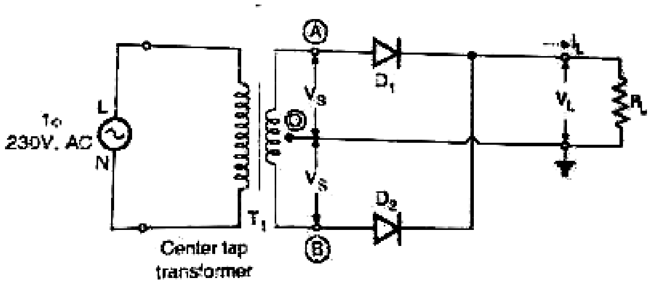
Current gets divided equally

$\therefore$ Current flowing through $R_3 = \frac{\text{Total current}}{2}$

$= \frac{0.1A}{2} = 0.05A$

Q.1(i) Draw circuit diagram of centre-tap full wave rectifier and label it. **[2]**

(A)



Q.1(j) State maximum power transfer theorem. **[2]**

(A) It states that for a given linear network represented by a thevenin's equivalent circuit, the maximum power will be transferred by the network to the resistive load, when the load resistance is equal to the thevenin's resistance

ie $R_L = R_{TH}$

Q.1(k) Define Clipper and Write its types **[2]**

(A) CLIPPERS

The clipper is a circuit which clips (or) removes the portion of the input signal without distorting the remaining part of the waveform. The clippers are of two types :

- Series Clipper
- Shunt Clipper

Q.1(l) What is rectifier ? Write types of rectifier. **[2]**

(A) Rectifier :

A rectifier may be defined as an electronic device, such *as a* P-N junction diode, used for converting alternating (AC) voltage or current into unidirectional (DC) voltage or current. Essentially, a rectifier utilizes a unidirectional conduction device or asymmetric conduction device. In the former case, the device conducts only in one direction such as in a vacuum diode or a P-N junction diode (neglecting a small reverse saturation current) while in the later case, the device conducts unequally in the two directions.

Types of Rectifier :

Rectifiers may be classified into the following two categories depending upon the period of conduction :

(1) Half-wave rectifier

A half-wave rectifier is one which converts an AC voltage into a pulsating voltage using only one half cycle of the applied AC voltage. The rectifying diode conducts during one-half cycle only.

(2) Full-wave rectifier

A full-wave rectifier is one which converts an AC voltage into a pulsating voltage using both cycles of the applied AC voltage. The rectifying diodes conduct during positive as well as negative half cycle of AC voltage. The following two circuits are commonly used for full-wave rectification.

(a) Centre-tap full wave rectifier.

(b) Full-wave bridge rectifier.

Vacuum diode rectifiers are no longer used and have been suspended by semiconductor diode rectifiers. We shall discuss the study of semiconductor diode as rectifiers.

Q.2 Attempt any FOUR of the following : **[16]**

Q.2(a) Draw the constructional diagram of Electrolytic Capacitor. Explain the working. **[4]**

(A) Aluminium Electrolytic Capacitor :

Construction : It is as shown in the following figure (a)

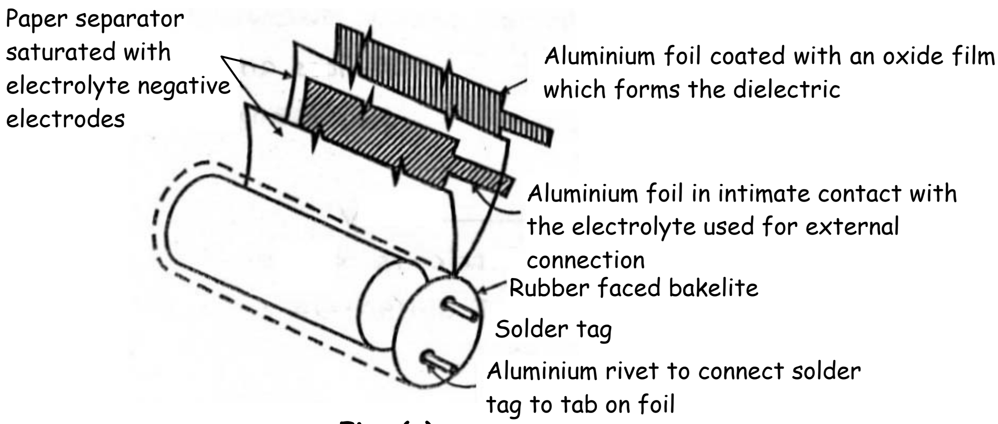


Fig. (a)

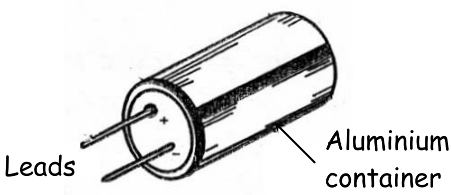


Fig. (b)

Construction of an aluminium electrolytic capacitor

It mainly consists of :
(i) First aluminium foil,
(ii) Oxide film,
(iii) Electrolyte,
(iv) Spacer,
(v) Second aluminium foil

This assembly is rolled up, the ends closed with wax and sealed into an aluminum container as shown in figure (b).

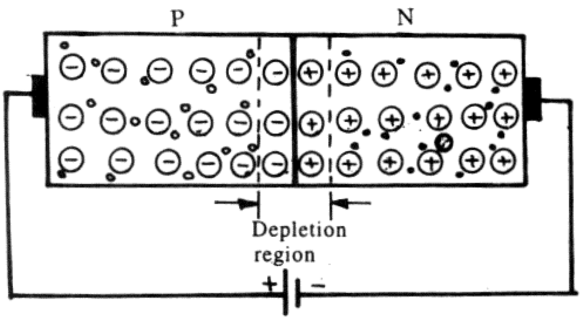
Specifications :	Capacitance range	:	$1\mu F - 1000\mu F$
	Temperature coefficient	:	200 ppm/°C
	Frequency range	:	10 Hz – 10 kHz
	Voltage range	:	6V – 400V
	Temperature range	:	–55°C to 150°C

Applications : Bypass, power supply filters.

Q.2(b) Describe the working of PN junction diode with neat sketch under forward biased condition. **[4]**

(A) P-N junction with forward bias

If we connect a battery to the P-N junction such that the positive terminal of the battery is connected to the P-region and the negative terminal to the N-region, then the P-N junction is said to be forward biased as shown in Fig.



Forward biased P-N junction

When a P-N junction is f e positive terminal of the battery (B) and are forced to move towards the junction. Similarly, the free electrons are repelled from the negative terminal of the battery and drift towards the junction. Because of their acquired energy, (from the battery B), some of the holes and the free electrons enter into the depletion region and recombine themselves.

This reduces the potential barrier and also reduces the width of the depletion region as well as the height of the potential barrier. In other words, the width of depletion region and the barrier potential reduces with the increase in forward bias. As a result of this, more majority carriers diffuse across the junction. Therefore, it causes a large current to flow through the P-N junction. This is called forward current.
It may be noted that for each recombination of free electron and hole, which occurs, an electron from the negative terminal of the battery enters the N-type region. Then it drifts towards the junction. Similarly, in the P-type region near the positive terminal of the battery, an electron breaks a covalent bond in the crystal and enters the positive terminal of the battery. Thus, for each electron, which breaks its covalent bond, a hole is created. This hole drifts towards the junction. The current through the external circuit is due to the movement of free electrons only. On the other hand, the current within the P-N junction is the sum of electron current (in the N-region) and hole current (in the P-region).

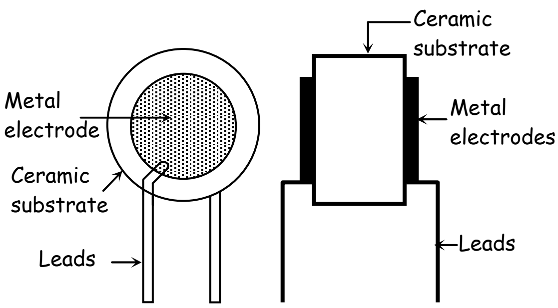
The electric current in the external circuit continues to flow as long as the battery is present in the circuit. The current increases with the increase in battery voltage and is of the order of several milliamperes. The maximum value of current depends upon the actual resistance called bulk resistance of the semiconductor material. The ohmic resistances of P-type and N-type semiconductor materials are called bulk resistances.

Q.2(c) Describe DISC CERAMIC CAPACITOR. **[4]**

(A) Disc Ceramic Capacitor

Construction : It is as shown in the following figure :

A disc of ceramic material is selected and on its both sides metal electrodes are plated. Connection leads are soldered to the metal electrodes. Finally the assembly is coated with suitable resin for protection.



Specification :

Capacitance range	:	10pF – 0.01μF
Temperature coefficient	:	150 ppm/°C
Frequency range	:	5kHz – 100MHz
Voltage range	:	150V – 6KV
Temperature range	:	–40°C to 80°C

Applications : Temperature compensation, coupling-decoupling circuits.

Q.2(d) Write the working principle of zener diode. **[4]**

(A) Working Principle

When a Zener diode is forward biased as shown in Fig. 1(a), it conducts the current due to majority carriers and behaves as an ordinary P-N junction diode. Therefore, its forward characteristic will be similar to that of an ordinary diode.

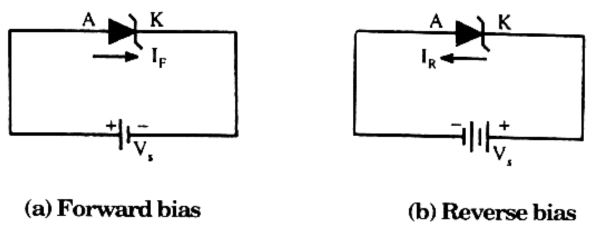


Fig. 1 : Conduction of Zener Diode

When a Zener diode is reverse biased as shown in Fig. 1(b), it conducts the current due to minority carriers and this current will be very small so long as the reverse voltage is less than breakdown voltage. As the reverse voltage is increased to breakdown voltage, a large number of electron-hole pairs are produced and the reverse current sharply increases. This reverse current is known as Zener current and the breakdown voltage is Zener voltage. If the voltage is again increased beyond the Zener voltage, then the Zener current increases, but the voltage across the Zener diode remains constant. Thus, it provides a constant voltage and can be used as a constant voltage source.

Q.2(e) Using four band colour code, find resistance value for : **[4]**

(i) Brown Red Red Silver **(ii) Yellow Violet Orange Gold**

(A) **(i) Brown Red Red Silver:**

- Brown 1
- Red 2
- Red 2
- Silver -/+ 10% i.e 12 X 102 = 1200 Ω = 1.2KΩ +/- 10%

(ii) Yellow violet orange gold:

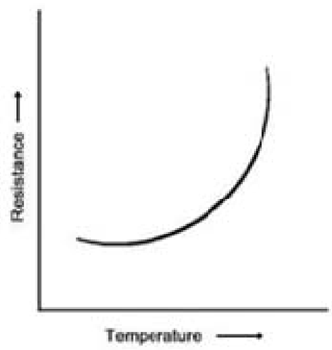
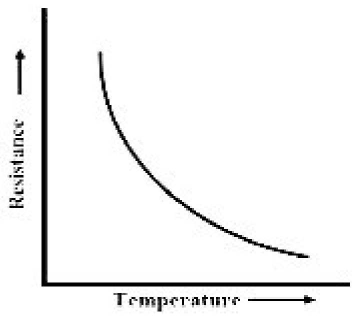
- Yellow 4
- Violet 7
- Orange 3
- Gold +/- 5% i.e. 47 x 103 = 47000 = 47KΩ +/- 5%

Q.2(f) Compare PTC and NTC thermistors w.r.t. **[4]**

(i) Materials used **(ii) Characteristics**

(iii) Temperature coefficient **(iv) Application**

(A)

	PTC	NTC
Materials used	Barium titanate, titanium oxide,	Manganese, nickel, cobalt,
Characteristics		
Temperature coefficient	60°C to 180°C	+200°C to +1000°C
Application (any 1)	Temperature sensing in electric motors and transformers for protection. Liquid level sensor To protect solid state fuse against excess current	For temperature measurement and control Temperature compensation Fluid flow measurement

Q.3 Attempt any FOUR of the following : **[16]**

Q.3(a) List different types of filters. Which filter is practically preferred to get pure DC output voltage? Why? **[4]**

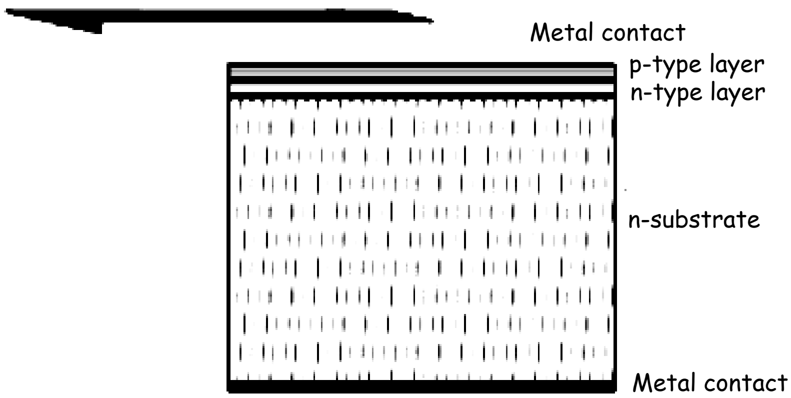
(A) Some of the passive filters used in the field of electronics are as given below :

(i) Series inductor (or choke) filters.

(ii) Shunt capacitor filter.
(iii) Choke input (LC or L type) filter.
(iv) Capacitor input (CLC or π type) filter.

π filter is preferred practically to get pure DC component as it has smaller ripple factor, even smaller than multisection LC filters. At high loads, there is higher DC o/p voltage. (Vdc = Vm).

Q.3(b) Describe the operating principle of Laser diode with neat sketch. **[4]**
(A)



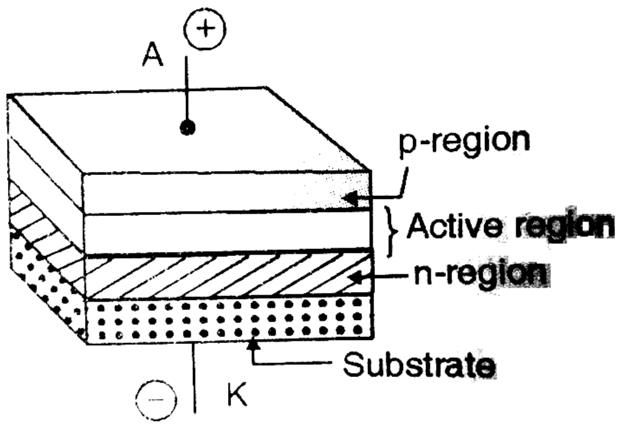
A laser diode is an electrically pumped semiconductor laser in which the active medium is formed by a p-n junction of a semiconductor diode similar to that found in a light-emitting diode. The laser diode is distinct from the optically pumped semiconductor laser, in which, while also semiconductor based, the medium is pumped by a light beam rather than electric current.

The gain region is surrounded with an optical cavity to form a laser.
In the simplest form of laser diode, an optical waveguide is made on that crystal surface, such that the light is confined to a relatively narrow line. The two ends of the crystal are cleaved to form perfectly smooth, parallel edges, forming a Fabry– Pérot resonator.

Photons emitted into a mode of the waveguide will travel along the waveguide and be reflected several times from each end face before they are emitted. As a light wave passes through the cavity, it is amplified by stimulated emission, but light is also lost due to absorption and by incomplete reflection from the end facets.

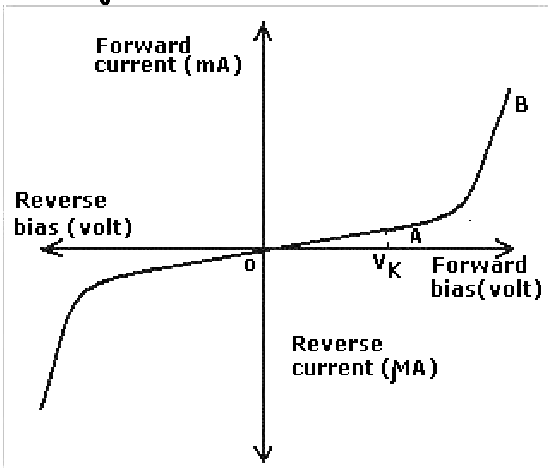
Finally, if there is more amplification than loss, the diode begins to "lase".

Q.3(c) Draw and describe construction of LED. **[4]**
(A) Construction of LED:



Q.3(d) Draw and describe V-I characteristics of P-N junction diode. **[4]**

(A) V-I Characteristics of a P-N junction:



Q.3(e) Define given parameters and state their values for bridge rectifier. **[4]**

(i) Ripple factor **(ii) PIV of diode**

(A) (i) Ripple factor:

- Ripple factor is defined as ratio of RMS value of AC component of output to the DC or average value of the output.
- Ripple Factor(r) =
- r = 0.482

(ii) PIV of diode:

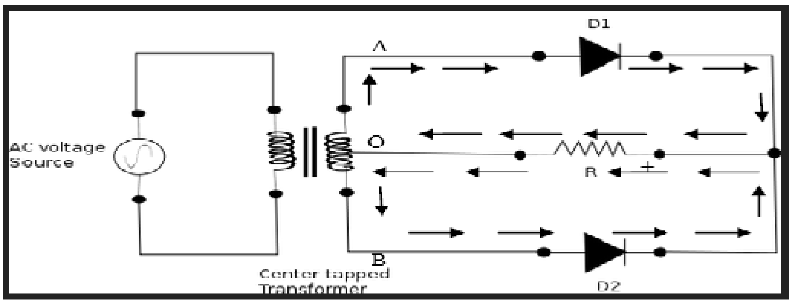
- This is the maximum negative voltage which appears across a non-conducting reverse biased diode.
- PIV = Vm (Volts)

Q.3(f) Draw circuit and describe working of full wave rectifier using centre tapped transformer. **[4]**

(A) Full wave Rectifier with Center tapped transformer(FWR):

- In full wave rectification, the rectifier conducts in both the cycles as two diodes are connected.

Circuit diagram:



Operation:

1. **In positive half cycle (0-Π).**
   - The end A of the secondary winding becomes positive and end B negative.
   - This makes diode D1 forward biased and diode D2 reverse biased. Therefore D1 conducts while D2 does not.
   - The conventional current flow direction in the upper half winding as shown in the fig above.

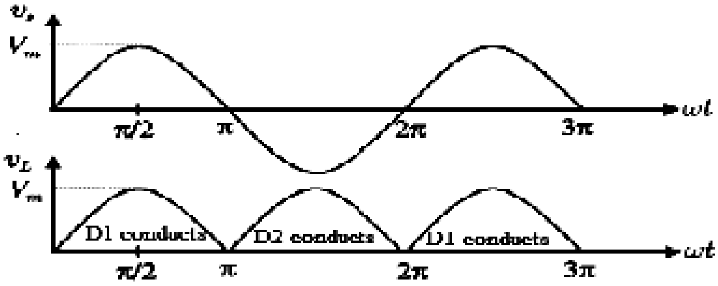
   A – D1 – RL – O

2. **In negative half cycle (Π-2Π):**
   - End A of secondary winding becomes negative and end B positive. Therefore diode D2 conducts while diode D1 does not.

- The conventional current flow is from as shown by the arrows in the above fig.

B – D2 – RL – O

- From fig. current in the load RL is in the same direction for both half-cycles of input AC voltage. Therefore DC is obtained across the load RL.



Q.4 Attempt any FOUR of the following : [16]

Q.4(a) What is the need of wave shaping circuits? [4]

(A) **Wave-shaping circuits :** Electronic circuits used to create or modify specified time-varying electrical voltage or current waveforms using combinations of active electronic devices, such as transistors or analog or digital integrated circuits, and resistors, capacitors, and inductors.

Most wave-shaping circuits are used to generate periodic waveforms.

The common periodic waveforms include the square wave, the sine and rectified sine waves, the sawtooth and triangular waves, and the periodic arbitrary wave. The arbitrary wave can be made to conform to any shape during the duration of one period. This shape then is followed for each successive cycle.

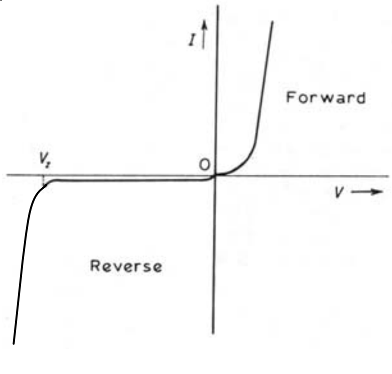
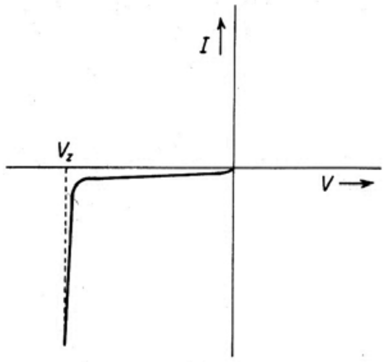
A number of traditional electronic and electromechanical circuits are used to generate these waveforms. Sine-wave generators and LC, RC, and beat-frequency oscillators are used to generate sine waves; rectifiers, consisting of diode combinations interposed between sine-wave sources and resistive loads, produce rectified sine waves; multivibrators can generate square waves; electronic integrating circuits operating on square waves triangular waves; and electronic relaxation oscillators can produce sawtooth waves.

In many applications, generation of these standard waveforms is now implemented using digital circuits. Digital logic or microprocessors generate a sequence of numbers which represent the desired waveform mathematically. These numerical values then are converted to continuous-time waveforms by passing them through a digital-to-analog converter.

Digital waveform generation methods have the ability to generate waveforms of arbitrary shape, a capability lacking in the traditional approaches.

Q.4(b) Compare PN-junction diode and Zener diode. (Four points) [4]

(A)

	PN-junction diode	Zener diode
(i)	Operated as fb or rb.	Always operated in rb region.
(ii)		 (a)
(iii)	Used in amplifiers, BJT	Used in voltage regulator circuit.

(iv)	Generally current flow due to majority carriers	current present due to minority carriers.

Q.4(c) State the superposition theorem with suitable example. [4]

(A) Superposition Theorem

It states that if a linear bilateral network contains more than one active sources, then the response (i.e. current or voltage) in any element is the algebraic sum of responses produced by each source acting alone; with all the other sources set equal to zero. When source is set = 0, it means

(i) it is still connected in the circuit (i.e. the internal resistance of the source is connected in circuit)

(ii) but it is turned OFF i.e.
when V source is turned OFF, V = 0 ∴ it becomes S.C.
when I source is turned OFF, I = 0 ∴ it becomes O.C.

For DC circuit the resultant response will be algebraic sum of responses due to all sources. While for AC circuits the resultant response will be algebraic sum of phasor current (or voltages)

Explanation of Superposition Theorem :

Consider figure 1(a), to find current through RL by superposition theorem.

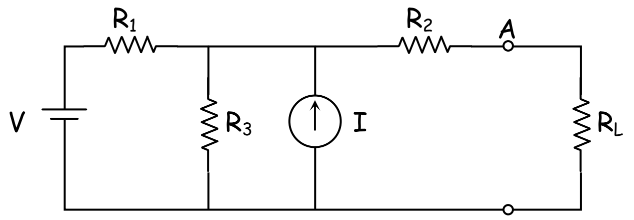


Fig. 1(a)

Following steps are taken.

(i) The current following through RL due to constant voltage source 'V' is found say IL1 (with proper direction), while open circuiting the current source as shown in fig 1(b).

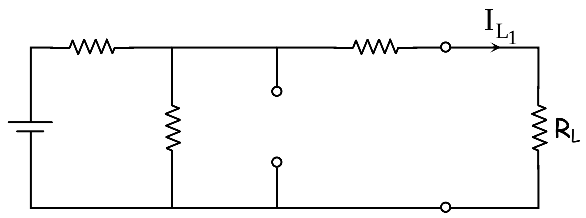


Fig. 1(b)

(ii) The current flowing through RL due to constant current source of I amps. is now found say IL2 (with proper direction)
While short circuiting the voltage source as shown in fig 1(c).

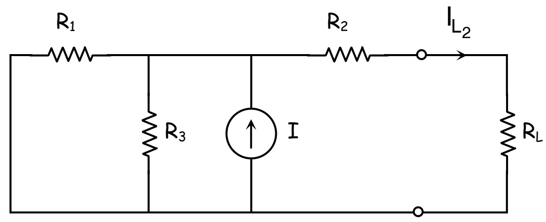
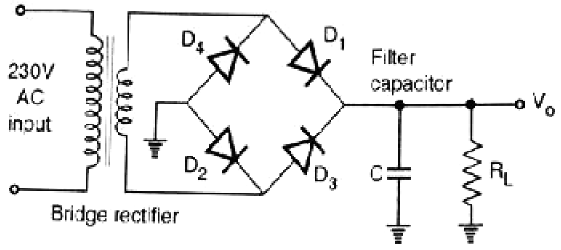


Fig. 1(c)

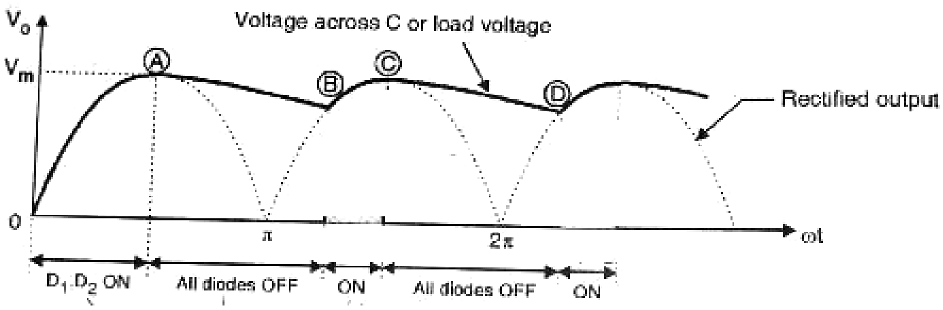
(iii) The resultant current IL through RL is found by superposition principle i.e. IL = IL1 + IL2.

Q.4(d) Draw circuit of capacitor filter with bridge rectifier. Draw input and output waveforms. [4]

(A) Capacitor filter with bridge rectifier

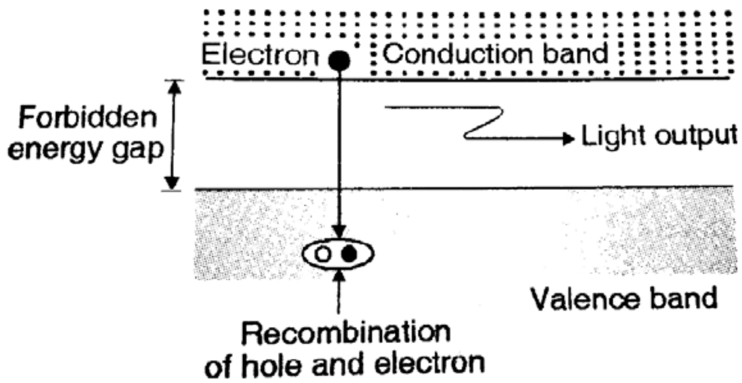


Waveforms



Q.4(e) State Operating principle of LED **[4]**

(A) Principle of Operation of LED:



- When an LED is forward biased, the electron in the n-region will cross the junction and recombine with the holes is p-type.
- When the recombination takes place, electrons from the conduction band resides these electrons return back to the valance band.
- While returning back, the recombining electrons give away the excess energy in the form of light.

Semiconductor Materials Used:

- Gallium Arsenide (GaAs) : Infrared (IR)
- Gallium Arsenide Phosphite (GaAsP) : Red or Yellow.
- Gallium Phosphite (GaP) : Red or Green.

Q.4(f) Short note on tunnel diode. **[4]**

(A)

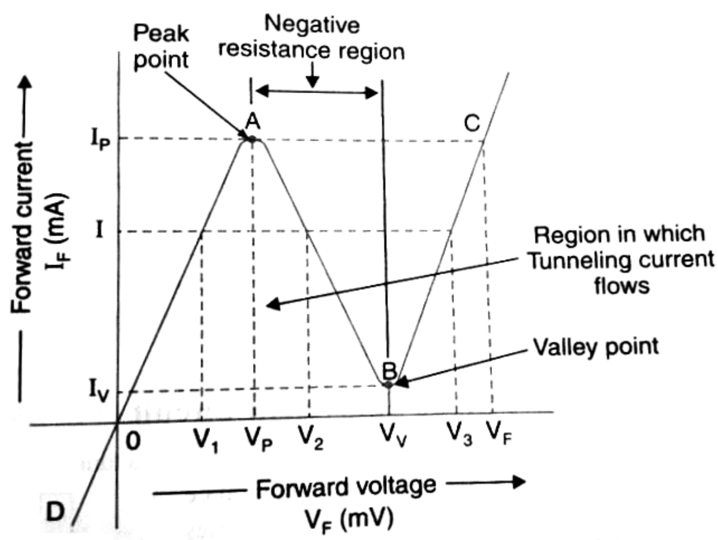


Fig. 13.8. V-I characteristic of a tunnel diode.

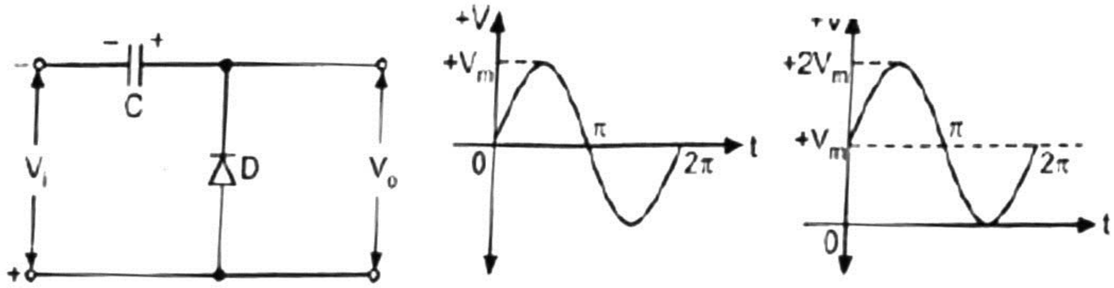
Applications:

- One of the important application of a tunnel diode is in high speed computers where the switching times in the order of nanoseconds or picoseconds are desirable.
- A tunnel diode can be used at such high speeds as a result of the electrons "punching through" at velocities that far exceed those in conventional diodes.
- The punching through takes place due to narrow depletion region.
- Some other applications are :
  1. In digital networks.
  2. As a high speed switch.
  3. As a high frequency oscillator.

Q.5 Attempt any FOUR of the following : [16]

Q.5(a) Draw and describe working of positive clamper. [4]

(A) Fig shows the circuit diagram of an unbiased positive diode clamper.



(a) Circuit diagram (b) Input waveform (c) Output waveform

fig shows the input waveform applied to the positive diode clamper.

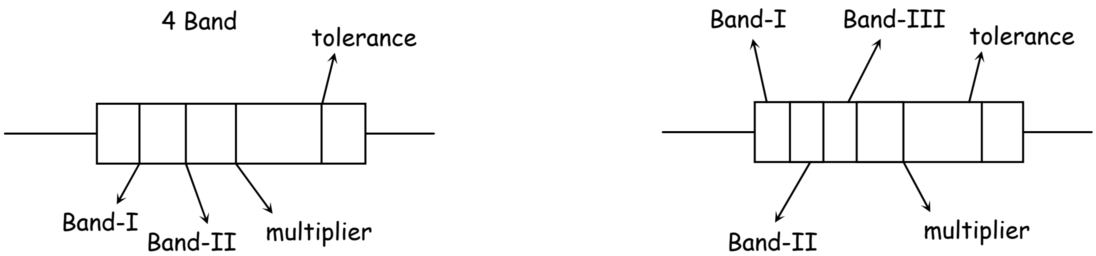
- During the negative half cycle of the A.C. input signal Vi, the diode D is forward biased and current flows through the circuit.
- The diode D acts as a short- circuit, i.e closed series switch and the capacitor C is charged to a voltage equal to the negative peak voltage –Vm.
- Once the capacitor is C is fully charged to –Vm, it is not discharged because the diode D cannot conduct in reverse bias condition.
- Now the capacitor C stores the charge and acts as a battery with an e.m.f equal to –Vm.
- The polarity of this voltage is such that it adds to the positive half cycle of the input signal. So the output voltage is equal to the sum of the input voltage Vi and the capacitor voltage Vm. The output will be given by,
- Vo=Vi+Vm=Vmsinwt + Vm.
- The input signal voltage at the output becomes twice the peak voltage of the input signal.
- The output signal will make excursion between zero level and +2Vm of the input signal.This causes the input signal to clamp positively at 0V,i.e. negative peak is clamped at zero level as shown in fig.

Q.5(b) How to read color bands on resistors? [4]

(A) **Read Color Bands on Resistors**

First hold the resistor in your left hand such that the end that has the bands closest to it will remain on your left side.

Now read from left to right, as shown below :



Details of Colour coding Bands

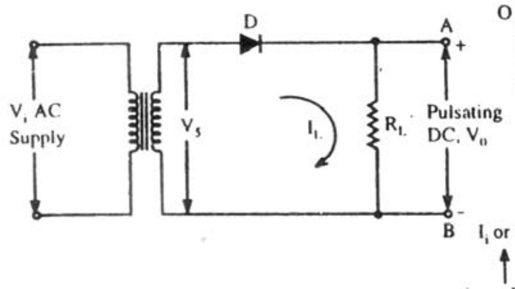
Colour	1^{st} side band	2^{nd} side band	Multiplier	Tolerance
Black	0	0	10^0	–
Brown	1	1	10^1	1 %
Red	2	2	10^2	2 %
Orange	3	3	10^3	–
Yellow	4	4	10^4	–
Green	5	5	10^5	0.5 %
Blue	6	6	10^6	0.25 %
Violet	7	7	10^7	0.1 %
Grey	8	8	10^8	0.01 %
White	9	9	10^9	–
Gold	–	–	10^{-1}	± 5 %
Silver	–	–	10^{-2}	± 10 %
No colour	–	–	–	± 20 %

Q.5(c) Draw the circuit diagram of series inductor filter with half wave rectifier. Explain with input and output wave forms. **[4]**

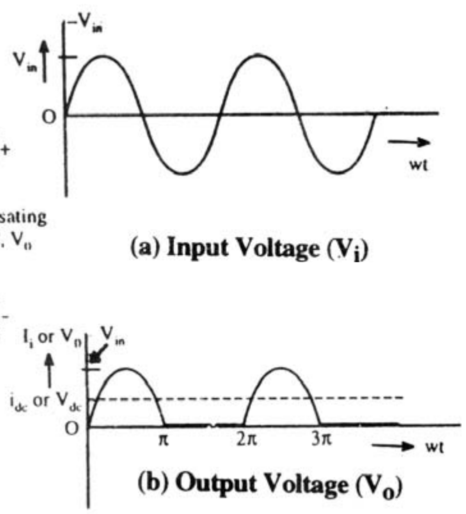
(A) Half-Wave Rectifier :

In half-wave rectification, the rectifier conducts current only during the positive half-cycles of input AC supply. The negative half-cycles of AC signal are suppressed i.e., during negative half cycles there is no current and hence no voltage drop across the load. Therefore, current always flows only in one direction (i.e. DC) through the load, though after every half-cycle.

Circuit Details:



Diode as a Half-wave rectifier



Waveforms

Fig. 1

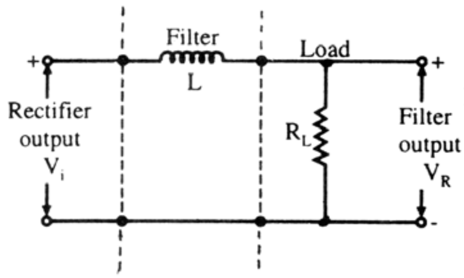


Fig. 2 : Rectifier and

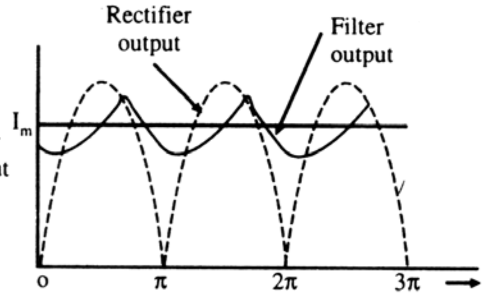
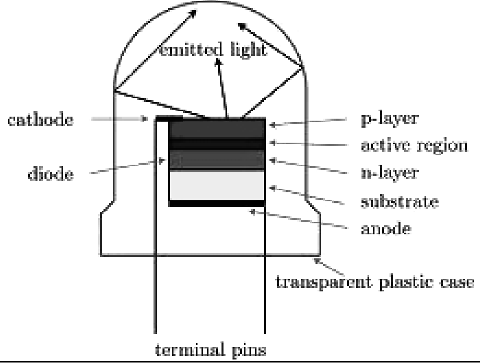
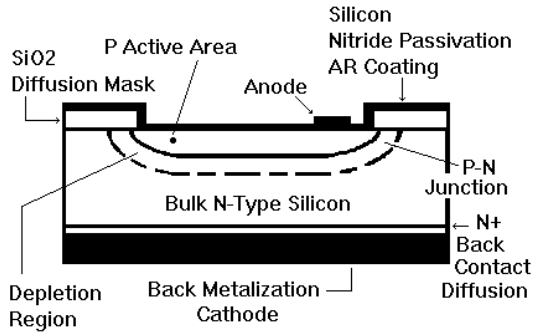


Fig. 3 : Series Inductor Filter output

Whenever the current through an inductor tends to change, a back emf is induced in the inductor. This induced emf prevents the current from changing its value. Any sudden change in current that might have occurred in the circuit without an inductor is smoothed out by the presence of inductor.

Q.5(d) Compare LED and Photo diode. (Four points) **[4]**

(A)

	LED	**Photodiode**
(i)	Emits light when forward biased.	Converts light energy to electrical energy.
(ii)	Works on principle of electro-luminance.	Works on principle of photoconduction.
(iii)		
(iv)	Applications : • Visual signs • Illumination where light is reflected from objects to give visual response of there objects. • Narrow band light sensors.	Applications : • Photoresistors • Photodetectors • Smoke detectors • Remote control • Measuring light intensity.

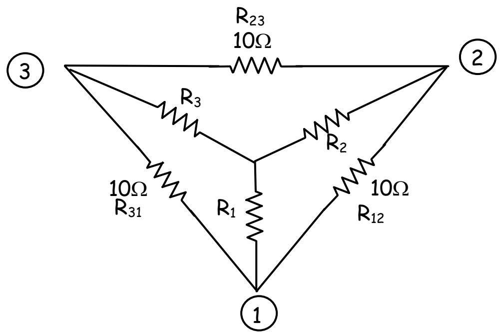
Q.5(e) If three resistors of 10 Ω each are connected in delta connection. Convert if into star connection. Draw circuit diagram for both. **[4]**

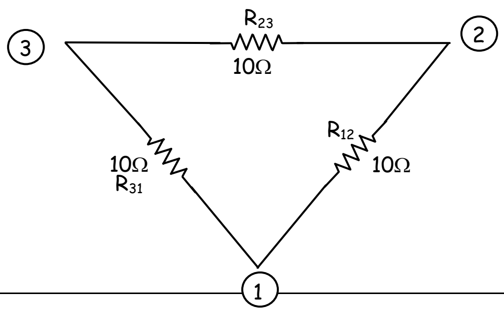
(A) Conversion of Δ to Y network

$$R_1 = \frac{R_{12} \times R_{31}}{R_{12} + R_{23} + R_{31}} = \frac{10 \times 10}{10 + 10 + 10} = \frac{100}{30} = 3.33\Omega$$

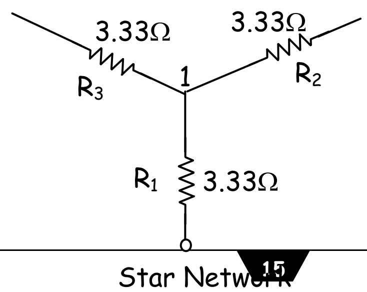
$$R_2 = \frac{R_{12} \times R_{23}}{R_{12} + R_{23} + R_{31}} = \frac{10 \times 10}{10 + 10 + 10} = \frac{100}{30} = 3.33\Omega$$

$$R_3 = \frac{R_{23} \times R_{31}}{R_{12} + R_{23} + R_{31}} = \frac{10 \times 10}{10 + 10 + 10} = \frac{100}{30} = 3.33\Omega$$





Delta Network



Star Network

Q.5(f) State : (i) Norton's theorem. (ii) Super-position theorem. [4]

(A) Norton's theorem Statement:

Any linear, active, resistive, network containing one or more voltage and / or current sources can be replaced by an equivalent circuit containing a current source called Norton's equivalent current ISC and an equivalent resistance in parallel.

Superposition theorem Statement:

Superposition theorem states that in any linear network containing two or more sources, the response (current) in any element is equal to the algebraic sum of the response (current) caused by individual sources acting alone, while the other sources are inoperative.

Q.6 Attempt any FOUR of the following : [16]

Q.6(a) Explain the following terms : [4]

(i) Active Network (ii) Linear Network

(iii) Bilateral Network (iv) Unilateral Network

(A) (i) **Active N/W :** A network containing one or more elements with energy sources is called active N/W. Active network contains passive elements also.

(ii) **Linear N/W:** A linear N/W is one whose parameters are constant i.e. they do not change with voltage or current.

(iii) **Bilateral N/W:** A Bilateral N/W is one in which relationship between current and voltage is same even if direction of current is reversed.

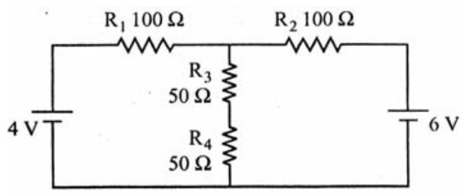
(iv) **Unilateral N/W :** A unilateral N/W is one in which relationship between current and voltage is changed, if direction of current is reserved.

Q.6(b) Give the comparison between Diffused junction diode and Point contact diode. [4]

(A)

	Diffused junction diode	Point-contact diode
(i)	N-type material is heated in a chamber containing high concentration of acceptor impurity in a vapour form. Some of the vapour atoms diffuse the material to form a junction diode.	A pointed tungsten whisker coated with indium is brought into contact, under pressure with a very thin N-tuype material soldered to a metal base to form a diode.
(ii)	The junction capacitance is low about 0.008 μF to 20 μF.	The barrier layer capacitance at the point is very low about 0.1 pF to 1 pF.
(iii)	The operating frequency is low about 100 MHz.	The operating frequency is very high about 10 GHz.
(iv)	It can handle larger currents.	It can handle low currents.
(v)	It has higher voltage rating.	It has smaller voltage rating.
(vi)	It is used as a power rectifier.	It is used as pulse circuits.

Q.6(c) Find current through resistance R_4 using super-position theorem. [4]

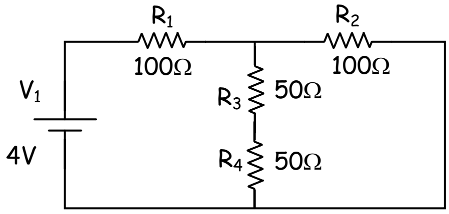


(A) Steps: Remove V_2, consider V_1 and calculate current R_4 due to V_1 voltage source.

$R_T = \dfrac{100 \times 100}{100 + 100} + 100$

$= 50 + 100$

$R_T = 150\Omega$



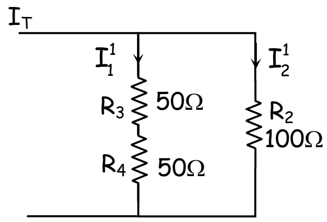
$I_T = \dfrac{4}{150}$ =0.0267 Amp.

Current through R_4 due to 4V is

$I_{1'} = \dfrac{100}{100+100} \times I_T$

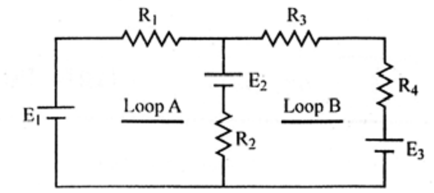
$= \dfrac{100}{200} \times 0.0267$

$I_{1'}$ =0.01335 amp

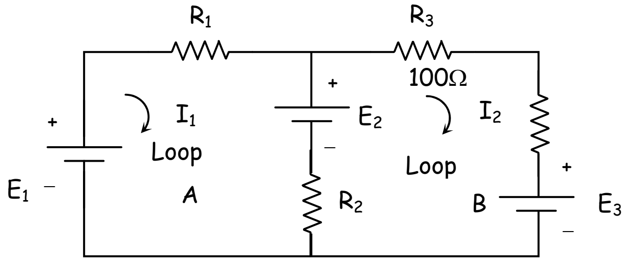


Hence current th^r R_4 is 0.01335 Amp.

Q.6(d) Using Maxwell's loop current method, write equations for Loop-A and Loop-B. **[4]**



(A)



Step 1 :– Using Maxwell's loop current method.

Write equation for loop A ⇒ ABEFA

$-I_1 R_1 - E_2 - R_2 (I_1 - I_2) + E_1 = 0$

$-I_1 R_1 - E_2 - I_1 R_2 + I_2 R_2 + E_1 = 0$

Step 2 :– Write equation for loop B ⇒ BCDEB

$-I_2 R_3 - I_2 R_4 - E_3 - R_2 (I_2 - I_2) + E_2 = 0$

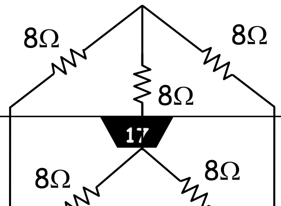
$-I_2 R_3 - I_2 R_4 - E_3 - I_2 R_2 + I_1 R_2 + E_2 = 0$

OR

$- I_2R_3 - I_2 R_4 - E_3 + R_2 (I_1 - I_2) + E_2 = 0$

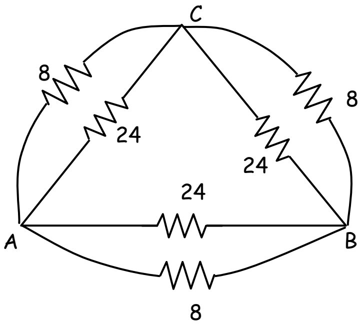
$- I_2R_3 - I_2R_4 - E_3 + I_1 R_2 - I_2 R_2 + E_2 = 0$

Q.6(e) Calculate equivalent resistance, R_{AB} between terminals A and B using delta-star transformation. (Refer Figure) **[4]**

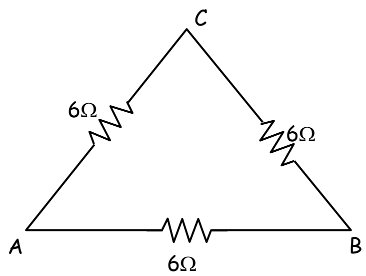


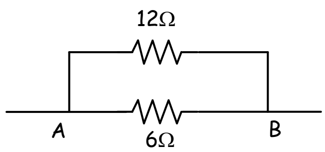
(A) Solving for inner star to delta:-
RAB = RAC = RBC = (8*8)+(8*8)+(8*8)/8=24 Ω So the circuit becomes:-

Redraw the circuit find R_{AB}

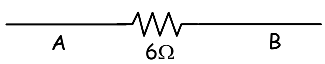


8//24 = 3





12//6 = 4Ω



R_{AB} = 4Ω

Note Please read 8// 24 = 6 ohms , and hence RAB = 12//6 = 4ohms

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