MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

Winter – 15 EXAMINATIONS

Subject Code: **17215**   <u>**Model Answer**</u>

<u>**Important Instructions to examiners:**</u>

1) The answers should be examined by key words and not as word-to-word as given in the answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.
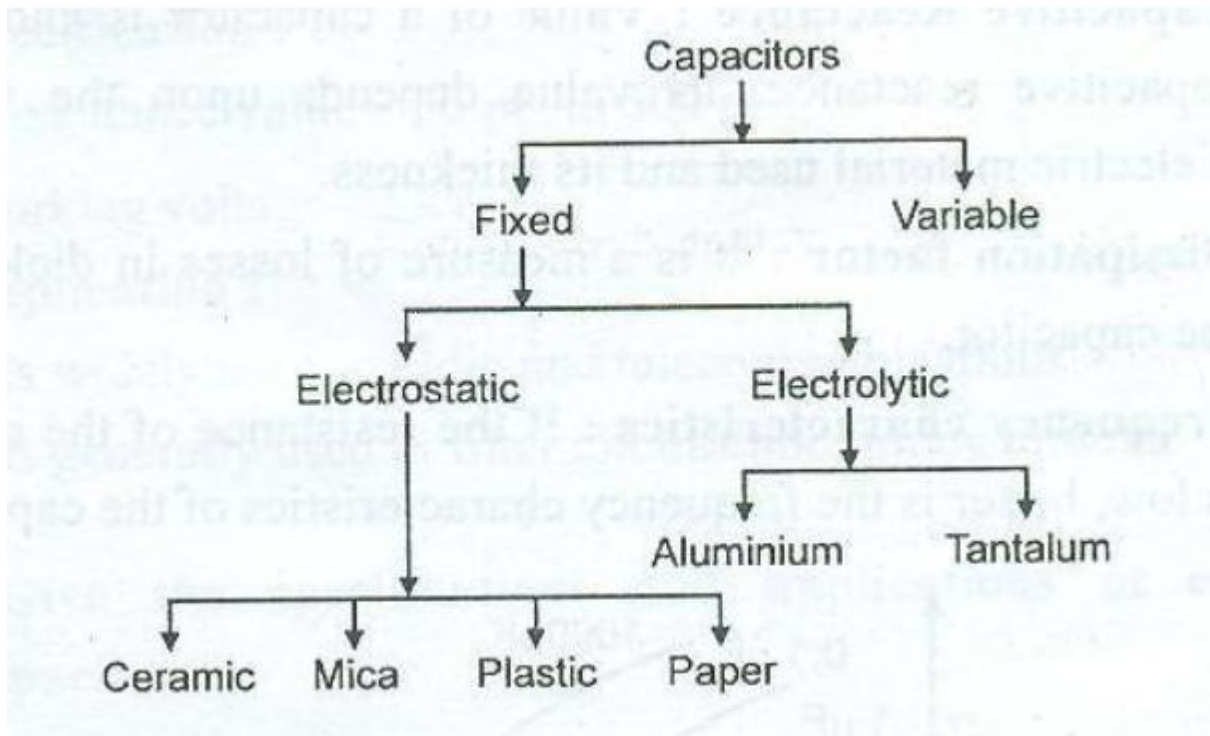
1. Attempt any TEN of the following: 20M

a. State the classification of capacitors.

Ans: **Classification of capacitors: 2M**

Classification of capacitor is as follows:

b. State the faraday's law of electromagnetic induction.

Ans: **Each law:1 M**

● **Faradays first law:**
The first law states that whenever the magnetic lines of force (flux lines) linking with a coil or conductor changes, an emf gets induced in the coil or conductor. Such an emf lasts as long as this change is taking place.

Faraday's second law:
Whenever a conductor cuts or is cut by the magnetic flux an emf is induced in the conductor the magnitude of which is proportional to the rate at which the conductor cuts or is cut by the magnetic field. In short the second law can be stated as:

The magnitude of the induced emf is directly proportional to the rate of change of flux linkage where flux linkage = Flux X Number of turns of coil.
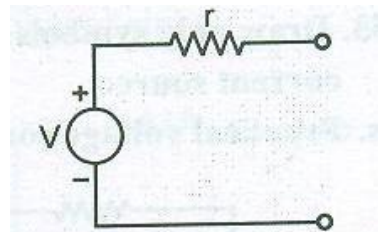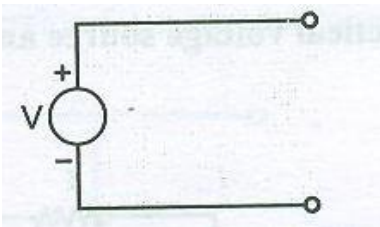
c. List the types of filters.

Ans c. Types of filters: 2M

The types of filters are:
i. Shunt capacitor filter or C filter.

ii. Series inductor filter or L filter.

iii. LC filter or choke filter

iv. π filter or CLC filter.

d. Draw the ideal and practical voltage source.

Ans d. Each diagram: 1M

Ideal Voltage Source   **Practical Voltage Source**

e. State Kirchoff's current law and voltage law (KCL and KVL).

Ans e. Each Law:1 M

Kirchoff's law KCL: 1 Mark
The algebraic sum of all currents entering or leaving a node must be equal to zero
Therefore,
$\Sigma I = 0$

Kirchoff's law KVL: 1 Mark
It states that "Algebraic sum of voltages in a loop or mesh is equal to zero"
Σ voltage= 0.

Write two applications of P- N junction diode and zener diode.

Ans f.

Application of P-N junction diode: 1 Mark (any two)
  ● Used in rectifier circuit
  ● Used in clipping and clamping circuit.

- Used for A.M detection
- Used for voltage multiplier.

Application of Zener diode: 1 Mark (any two)
- It is used as voltage regulator.
- Used in protection circuits for MOSFET.
- Used in pulse amplifier.
- Used in clipping circuits.
g. Define self-inductance and mutual inductance.

Ans g.

Self-inductance: (1M)
As per the Lenz's law, the self induced emf opposes any current change taking place.

This property of the coil to oppose any change in current flowing through it is known as the self-inductance or inductance.

Mutual inductance: (1M)
It is defined as the property due to which the change in current through one coil produces an emf in the other coil placed nearby, by induction. It is denoted by M and measured in Henry.

h. Write colour code of 1kΩ resistor.

Ans h. **Correct colour code: 2M**

1 kΩ

1×10^3

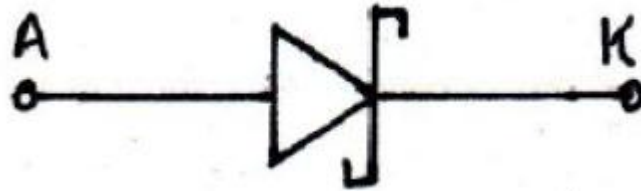10×10^2

Brown, Black, Red

i. Define Q factor.

Ans i.

Q factor: The ability of an inductor to store energy as compared to the dissipation of energy within the inductor is called quality or Q factor.
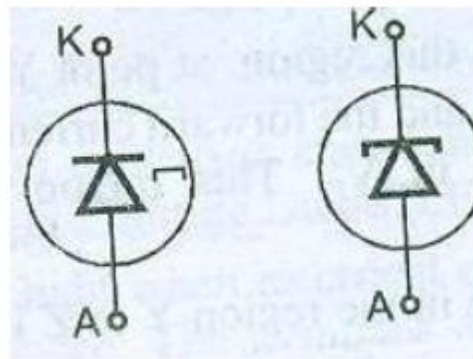
j. Draw the symbol of Schottky diode, Tunnel diode, PIN diode, Zener diode.

Ans j.

Schottky diode

Tunnel diode
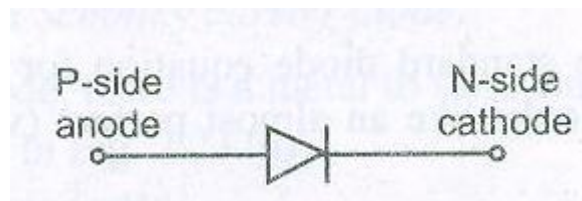
PIN diode
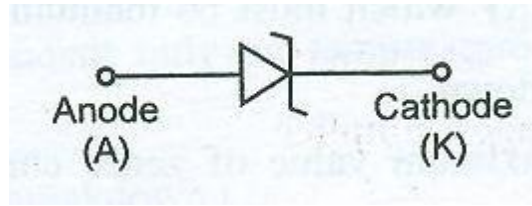
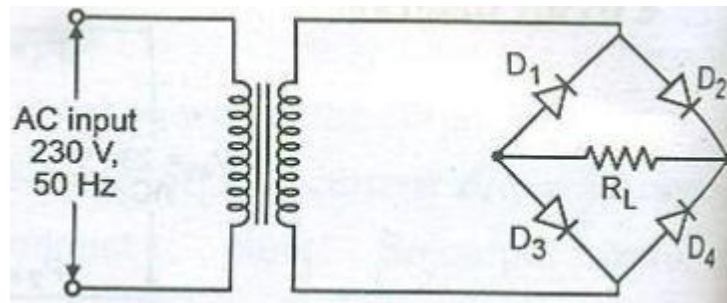**Zener diode**

k. Draw the circuit diagram of bridge rectifier and show its output waveform.

Ans k. Circuit diagram:1M; Output Waveform:1M

Circuit Diagram Bridge rectifier
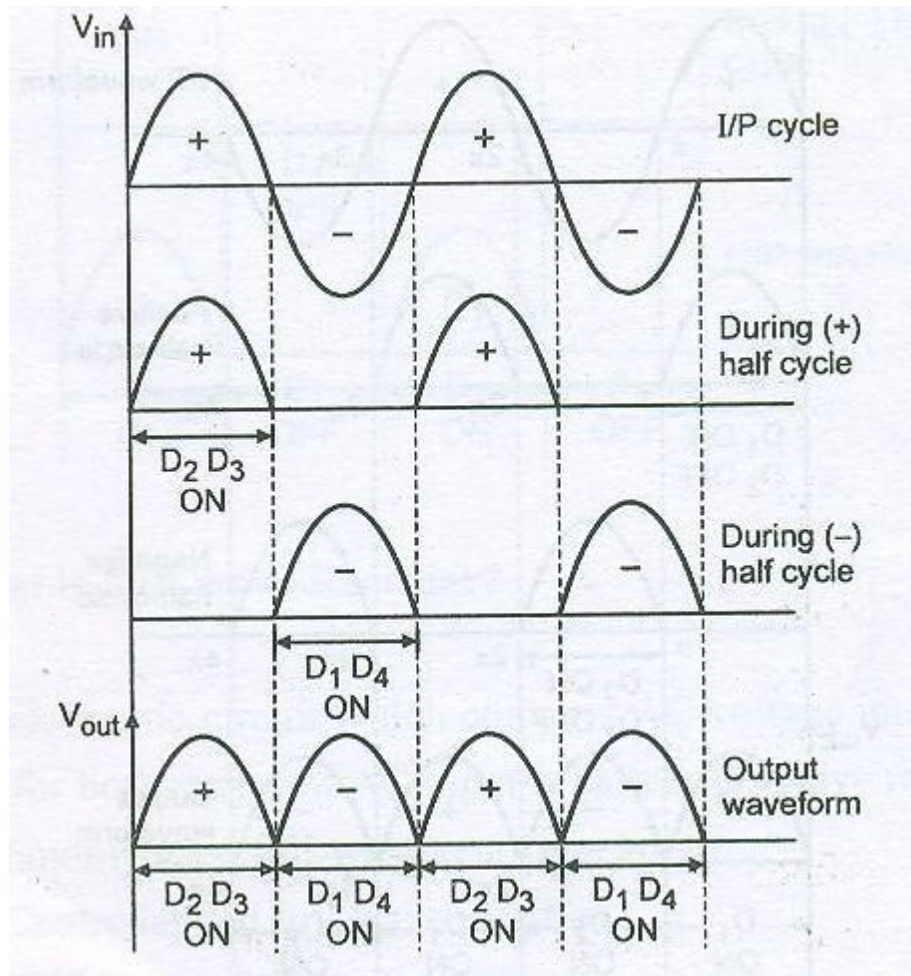
Fig: Output waveform

l. Calculate the current through 5Ω resistor shown in fig no-1
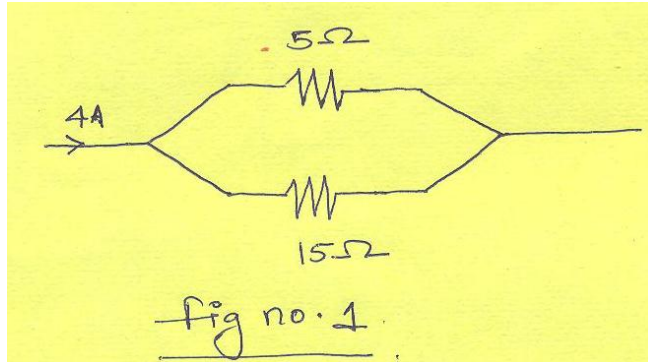
Ans

(Correct Answer – 2 Marks)

$I_1 = [15 /(5+15)] \times 4$
$= (15/ 20) \times 4$
$I_1 = 3$ Ampere

m. Give the need of rectifier.

Ans m.

Need of Rectifiers: 2 Mark
- Many electronic devices such as diodes, transistors and IC's works on D.C. but not on A.C.
- It is then needed to convert A.C. into D.C.
- Rectifier is the best and cheapest way to provide D.C. current for electronic devices.

n. State the parameter of rectifier.

Ans n. **Any two parameter of rectifier- 2M**

- Average load current
- Average load voltage
- RMS load current
- RMS load voltage
- Ripple factor
- Voltage regulation
- Rectification efficiency and TUF.

2. Attempt any FOUR of the following: **16**
a. Draw the constructional diagram of electrolytic capacitor and explain the working.

Ans a. **Constructional Diagram:2M; Working:2 M**

: Construction of an aluminium electrolytic capacitor

: Electrolytic capacitor
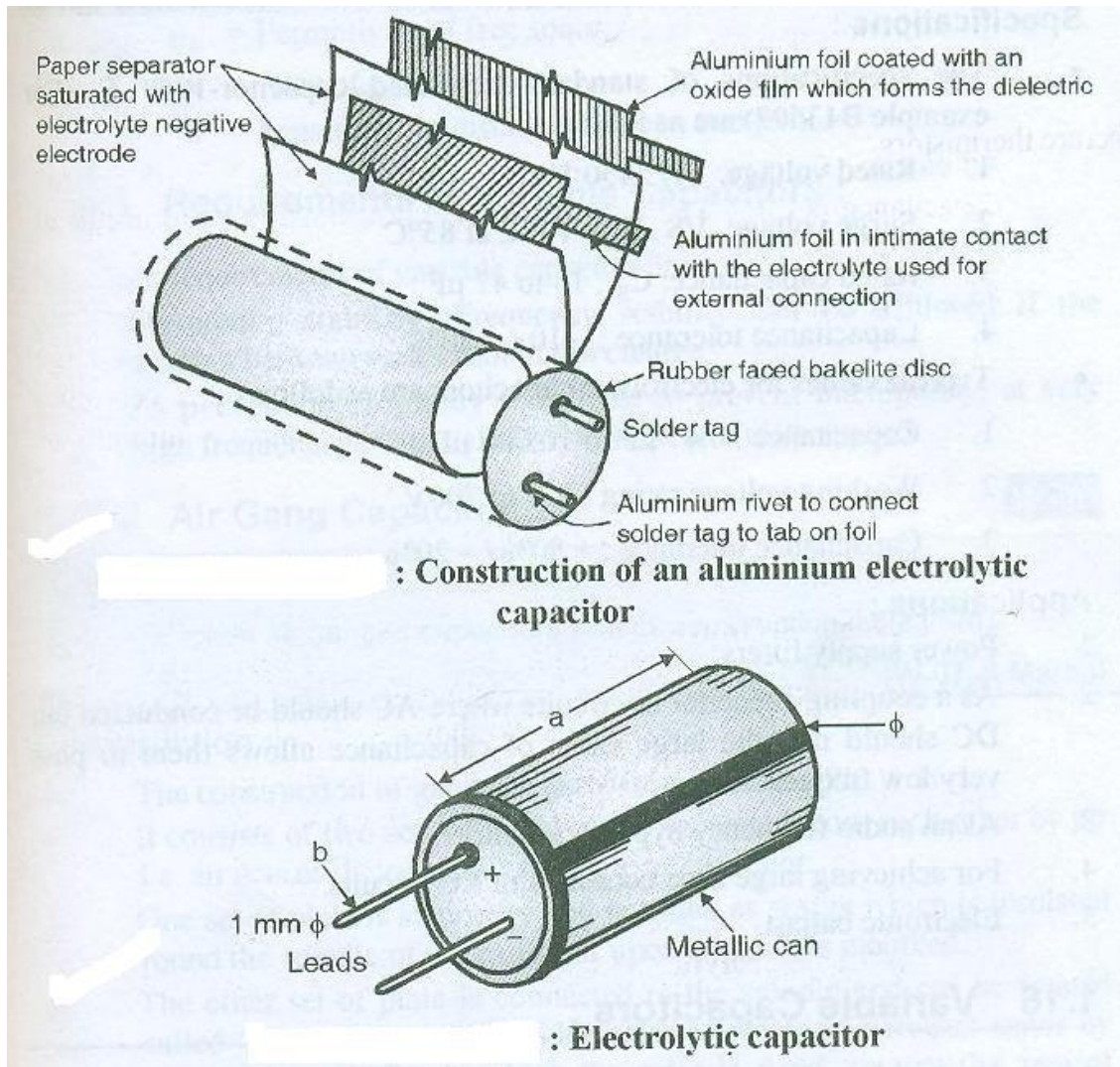
- Electrolytic capacitor is a polarized capacitor. This type of capacitor consists of pasty, semiliquid electrolyte between aluminum foil electrodes or plates.
- An electrolytic capacitor is a type of capacitor typically with a large capacitance per unit volume than other types than other types, making them useful in high current and low frequency electrical circuits.
- Electrolytic capacitors have highest capacitance voltage (CV) product in a given case size as well as the largest capacitance value. The large capacitance values are attainable because of the use of a very thin dielectric film formed by oxidizing a metal usually aluminum tantalum.

b. Write the specifications of linear and non- linear potentiometers. State its applications (four points).

Ans b.

Specifications of linear & nonlinear potentiometers: (Any four Correct Points- 2 Marks)
1. Ohmic range: 10Ω to $125 \text{ k}\Omega$

2. Power rating : 100watt to 200 watt

3. Tolerance : $+ 2\%$

4. Voltage Rating: 5V-500V

5. Operating Temperature: 100oC

6. Power wattage: 1W and 3W

Applications of linear & nonlinear potentiometers: (Any four Correct Points- 2 Marks)
1. In DC power supplies to vary the output voltage.

2. In signal generators to vary the amplitude of output voltage.

3. IN radio receiver (as a volume control)

4. In TV receiver as volume control.

5. In amplifier circuits.

6. In the public address amplifier (P.A.) system.

7. Used as potential dividers.

8. It is used for panel control in receivers, function generator etc

c . Draw the characteristics of tunnel diode and write two applications of it.

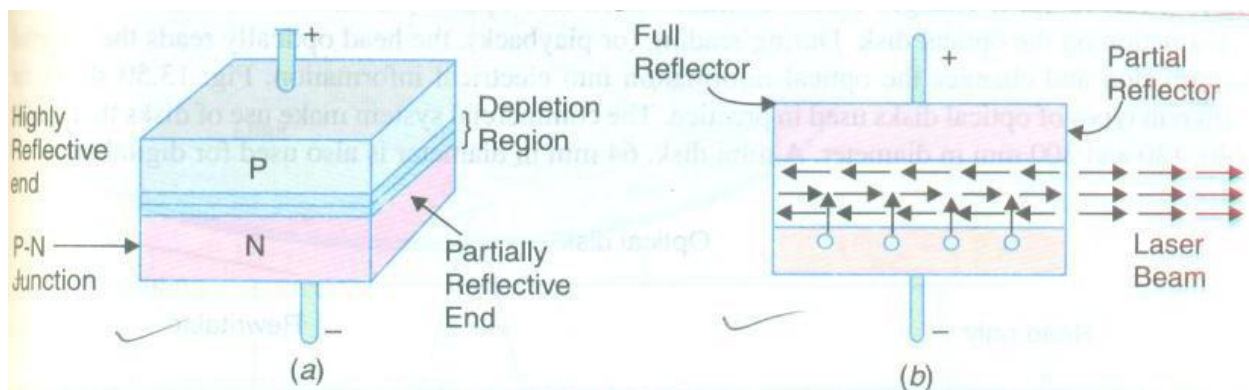Ans c. **Characteristics: 2Marks, Any two applications: 2Marks**
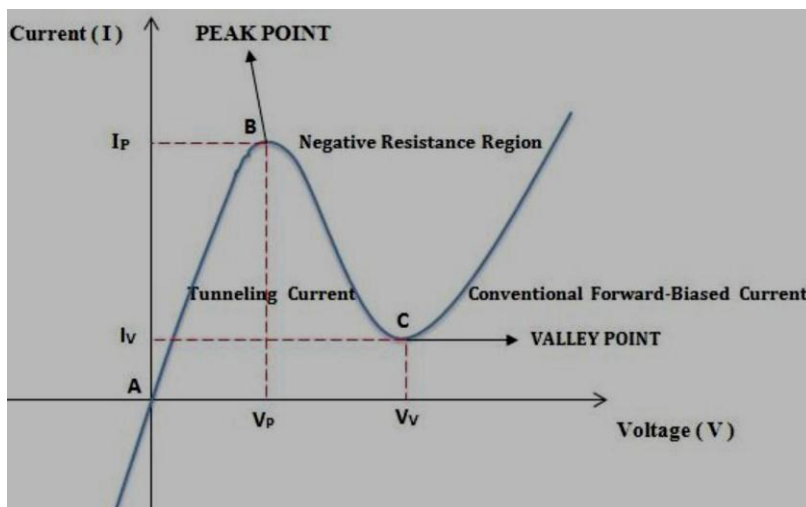
Applications:

1. In the digital networks

2. As a high speed switch

3. As a high frequency oscillator

4. High speed computers

d . Describe the operating principle of LASER diode with constructional diagram.

Ans d. **Operating principle: 2M; Constructional diagram: 2M**

- Like LEDs, laser diodes are typical PN junction devices used under a forward-bias. The word LASER in an acronym for Light Amplification by Stimulated Emission of Radiation. A P-N junction is formed by two layers of doped gallium arsenide (GaAs).

- When the P-N junction is forward-biased by an external voltage source, electrons move across the junction and usual recombination occurs in the depletion region which results in the production of photons. As forward current is increased, more photons are produced which drift at random in the depletion region. Some of these photons strike the reflective surface perpendicularly.

- These reflected photons move back and forth between the two reflective surfaces. The photon activity becomes so intense that at some point, a strong beam of laser light comes out of the partially reflective surface of the diode.

e. List specifications of resistors and explain any two.

Ans e. **Listing:2M, Explain any two:1M each**

(Note: Weightage to be given to any of the listed specification explanation)

List specifications of resistors are as follows:

1. Maximum voltage rating.
2. Power rating.
3. Temperature co- efficient of resistance.
4. Tolerance.
5. Operating temperature.
6. Ohmic range.

Explain any two:

Power rating: Power dissipation is amount of power that is converted to heat, light or other form of energy.

Tolerance: It is defined as deviation from nominal value of resistance in percent.

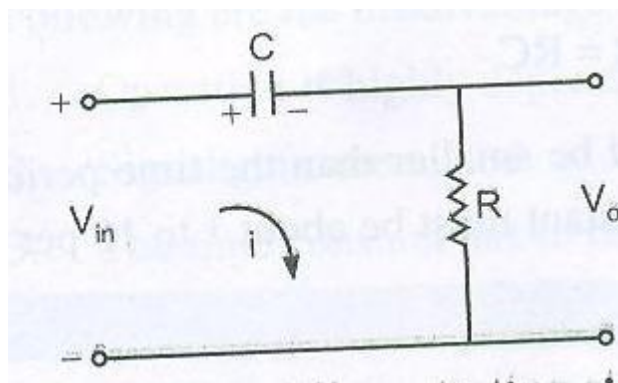f. Explain the working of RC differentiator.

Ans f.

Fig: RC differentiating circuit

- Figure shows a RC differential circuit. It is also known as high pass filter. The reactance of a capacitor decreases with increasing frequency.

- The higher frequency components in the input signal appear at the output i.e. the capacitor acts as a short circuit for very high frequencies and virtually all the input appears at the output. Therefore, it is also called as high pass RC circuit.

- In above circuit the voltage drop across R will be very small in comparison with the drop across C. Hence, the current is completely determined by the capacitance C.

- The value of current I will be,
  $I = C \times dvi / dt$
  The output voltage Vo is as given,

  $. Vo = iR$

$V_o = RC \times dv_i / dt$ (where R and C are constants)

$V_o \, \alpha \, dv_i / dt$

i.e. the output signal is directly proportional to the derivative of the input signal
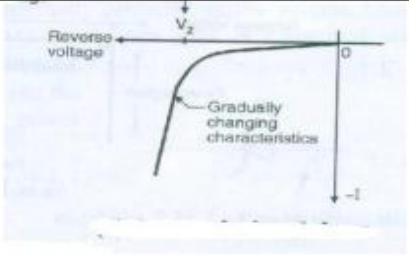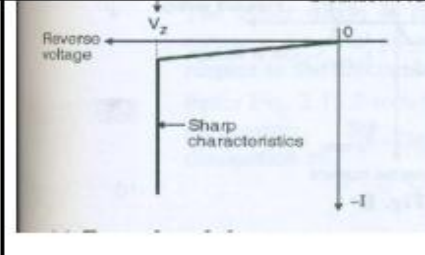
3. Attempt any FOUR of the following   16

a) Compare Avalanche and Zener breakdown.

Ans:- (4 relevant points- 4 mks)

The difference between Avalanche breakdown and Zener breakdown is as under :

Sr. No	Avalanche breakdown	Zener breakdown
1.	It occurs in junctions which are lightly doped and have wide depletion widths.	It occurs in junctions which are heavily doped and have narrow depletion widths.
2.	It occurs at higher reverse voltages when thermally generated electrons get enough kinetic energy to produce more electrons by collision.	It occurs due to rupture of covalent bonds by strong electric field set up in depletion region by the reverse voltage.
3.	At reverse voltages above 6 V, breakdown is due to Zener effect.	At reverse voltage below 6 V, breakdown is due to avalanche effect.
4.		

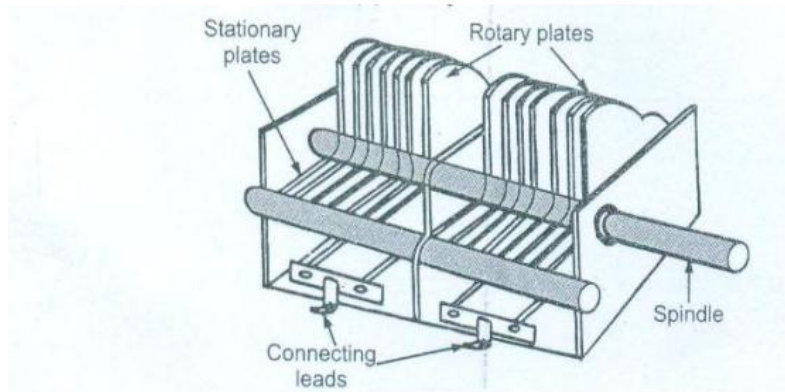b) Explain air gang capacitor with its constructional diagram.

Ans☺ Diagram – 2 mks, explaination-2 mks)
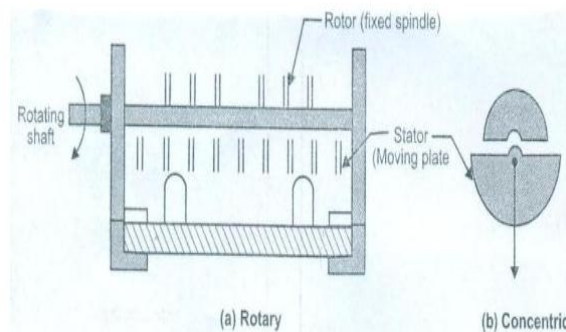
(a) Rotary   (b) Concentric

OR

Construction : (2M)

- Consider the structure of the above figure. It mainly consists of two sets of aluminium plates separated from each other by air. These metal plates may be rotary or concentric type.

- The rotary type configuration has a rotor and a stator. The concentric type of configuration has two cups of aluminium.

- The concentric type variable capacitor consists of two cups of aluminium, one moving in other. The movement is actuated by a threaded screw.

- One set of the plates is fixed, while the other set is connected to a shaft and can be rotated.

- The fixed set of plates is insulated from the body of a capacitor on which it is mounted.

- The set of moving aluminium plates can be moved in or out of a fixed set of plates with the help of a suitable knob connected to a rotating shaft. As the plates are moved in and out of the fixed plates, the capacitance value varies.

- The capacitance is minimum, when the moving plates are completely out and it is maximum, when the moving plates are completely in.

- The fixed plates are called stators, which are normally made of brass, copper or aluminium. The cadmium plated steel is used for the frames in low cost capacitors.

- The outer set of plates is called rotors. They get interleaved with stators, when the shaft is rotated. Sometimes, two or more such capacitors are operated by a single shaft.
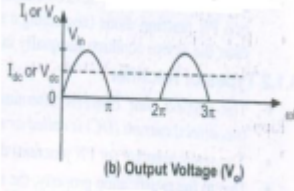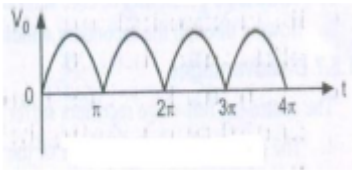
c) Compare half wave and centre tapped full wave rectifier with respect to
i) No of diodes
ii) PIV
iii) Efficiency
iv) Nature of output waveform
Ans:- (Each relevant point comparison – 1 mks each)

Sr no.	Parameters	HWR	CTFWR
1	No of diodes	1	2
2	PIV	Vm	2Vm
3	Efficiency	40.2%	81.2%
4	Nature of o/p waveform	Rectifies only one half cycle	Rectifies both half cycles

d) Explain the working of schottky diode.

Ans:- (Construction- 2 mks,, Explanation – 2 mks)
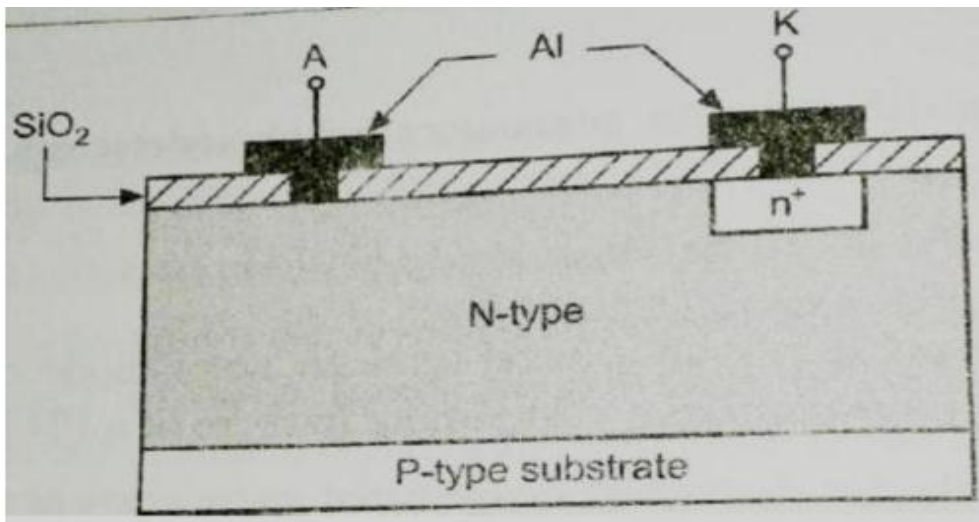
Working

- The metal region of a Schottky diode is heavily occupied with the conduction band electrons and the N-type region is lightly doped.

- There are no minority carriers as in other types of diodes, but there are only majority carriers as electrons. It operates only with majority carriers.

- When it is forward biased, higher energy electrons in the N regions are injected into the metal region where that gives up their excess energy very rapidly.

- Since there are no minority carriers as in conventional diodes, there is no charge storage and hence there is no reverse recovery diode when it is switched from the forward-biased condition (i.e. ON state) to the reverse biased condition (i.e. OFF state).

- It has negligible storage time and hence there is a very rapid response to a change in bias. Because of this property, it acts as a very fast switching diode.

e) Explain the VI charactertistics of zener diode.

Ans:- (V-I characteristics 2 mks, description- 2 mks)
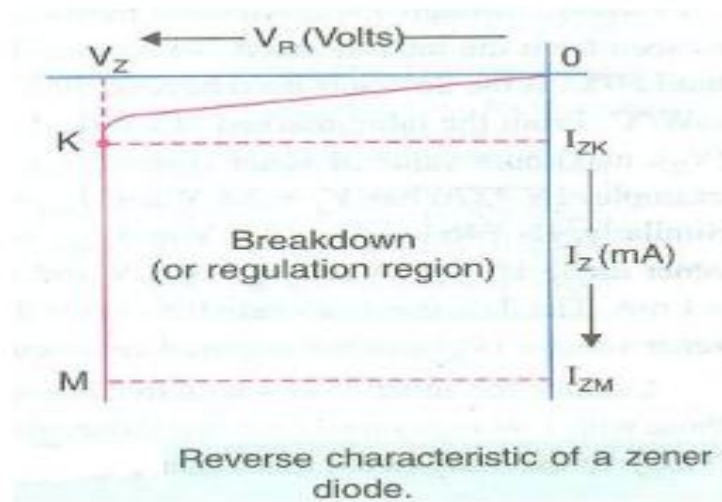
Reverse characteristic of a zener diode.

Description:-

A zener diode is operated only in the reverse-bias region. (generally written as V_R) is increased, the reverse current (usually called zener current, I_Z) remains negligibly small up to the 'knee' of the curve point. At this point, the effect of breakdown process begins.

From the bottom of the knee, the breakdown voltage (also called zener breakdown voltage or simply zener voltage V_Z) remains essentially constant. This ability of a diode is called regulating ability and is an important feature of a zener diode. It maintains, an essentially a constant voltage across its terminals over a specified range of zener current values.

Following two points are important from the characteristics of a zener diode :

1. There is a minimum value of zener current called breakover current designate a I_{ZX} or $I_{Z(min)}$ which must be maintained in order to keep the diode in breakdown (or regulation) region. When the current is reduced below the knee of the curve, the voltage changes drastically and the regulation is lost.

2. There is a maximum value of zener current designated as I_{ZM} or $I_{Z(max)}$ above which the diode may be damaged. The value of this current is given by the maximum power dissipation of the zener diode. As long as the maximum power dissipation is not exceeded, the diode will not be damaged. It will come out of the breakdown region, when the applied reverse voltage is reduced below the breakdown voltage.

f) Draw and describe the working principle of IRLED.

Ans:-
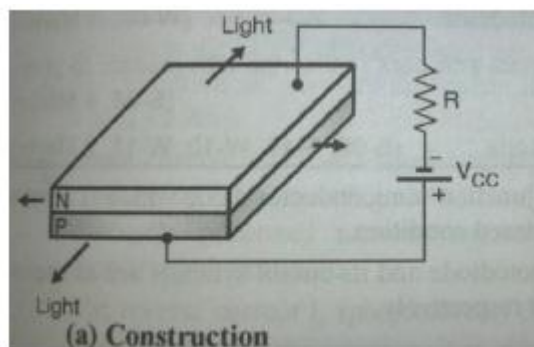
(a) Construction

Infra Red Light Emitting Diode (IR-LED):　　(2 mks)

Fig (a) shows the construction of IR-LED and fig (b) shows its characteristics.

This type of LED emits light in the infrared region of electromagnetic spectrum.

Principle   **2M**

- The IR-LED is a PN junction diode. It is of Gallium Arsenide (Ga As) and is operated in the forward biased condition.
- When the forward voltage is applied, the electrons from the N-side will recombine with the holes on P-side in the recombination region between P and N regions.
- During every recombination some of energy is released which is radiated in the form of Infra-Red light

4. Attempt any FOUR of the following   16

a) State the advantages of L and C filter.
 Ans:- **Advantages of L filter**   **(½ Mark for any 4 correct point)**

1. It has low ripple factor at heavy load currents (i.e. low load resistance)
2. It has no surge current through the diode.
3. It reduces the ripple in the DC output of rectifier circuit.
4. The L filter is more suitable for heavy loads.

Advantages of C filter   **(½ Mark for any four correct points)**

1. It is easy to design
2. It is small in size and cheap
3. It has low ripple factor for heavy loads.
4. It has high output DC voltage for light loads.
5. It is more suitable for light loads.
6. It has no load voltage equal to maximum transformer voltage.

b) Using colour codes, write the colour codes for the following

 resistors-

i. 680 KΩ, ± 5%   ii.   3.3 Ω, ± 10%

Ans. **(Correct Code – 2 Marks Each)**

 i.   680 KΩ, ± 5%

        6   8   x 10^4 ± 5%

Blue   Grey   Yellow   Gold

   ii.   3.3 Ω, ± 10%

3	3	x 10^{-1}	± 10%
↓	↓	↓	↓
Orange	Orange	gold	Silver

c) Draw and explain B-H curve.

Ans:-(Graph- 2 mks, relevant explanation-2 mks)

 B-H Curve –The curve or graph for magnetic field intensity Vs field density
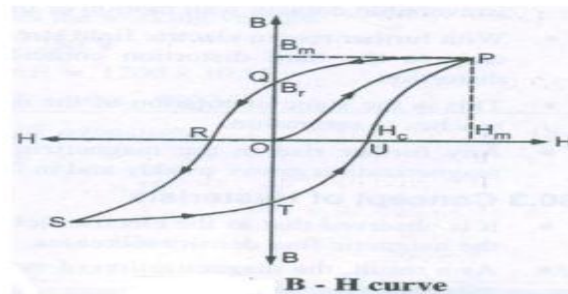
B - H curve

Explanation:-

- The magnetization curve of magnetic material specimen between the flux density B and the field intensity H is known a B-H curve. It is also known as Hysteresis curve.
- The B-H curve can be plotted by increasing and then decreasing the field intensity as shown in figure.
- The flux density B increases, when external field intensity H applied to it is increased.
- When the saturation of flux density arises, the increase in flux density ceases even though the field strength is increased. This is shown by OP.
- If the external field is gradually reduced, then the original curve Op is not retraced, but follows the curve PQ.
- When external field is reduced to zero, the magnetic flux does not reduce to zero, i.e. material remains magnetized.
- The value of flux density OQ is called remanant flux density Br (or residual magnetism).
- In order to demagnetize the material completely, the external magnetic field must be reversed and when it reaches the value OR in reverse direction, it is seen that the flux density is zero.
- Further increase of field intensity in the reverse direction will now increase the flux density in reverse direction and again at the point S, the saturation occurs.
- The residual magnetism in reverse direction is represented by OT and to neutralize it the magnetic field intensity must be increased in positive direction to the value OU.
- Further increase in field intensity will again magnetize the material and again saturation will occur at P.
- When the magnetic material is taken through one complete cycle of magnetization, it traces the loop that is called hysteresis loop.
- When a material is subjected to cyclic changes of magnetization, the domains change the direction of their orientation in accordance with field intensity.
- The work is done in changing the direction of domain which leads to the production of heat within the material.
- The energy required to take the material through one complete cycle of magnetization is proportional to the area enclosed by the loop.

d) State Nortons theorem with suitable example.

Ans:- **(Statement – 2 Marks, Example – 2 Marks)**

Statement:-"Any linear, active, resistive, network containing one or more voltage and / or current sources can mbe replaced by an equivalent circuit containing a current source called Norton's equivalent current I$_{SC}$ and an equivalent resistance in parallel."
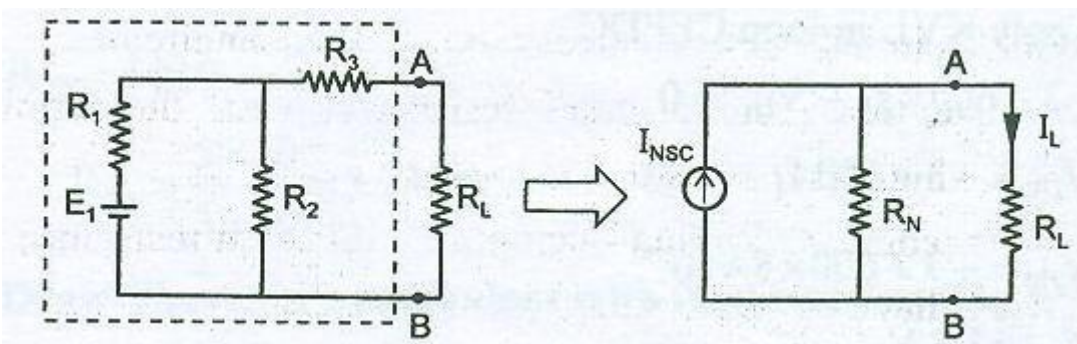
Explanation with example

1. Remove R_L

2. Short Terminals A&B.

3. Calculate flowing through A &B when short circuited.

   This current is I_{NSC}

4. To calculate R_N replace all energy sources by their internal resistance if any and if not then voltage source is replaced by short circuit whereas current source is replaces by open circuit w.r.t terminal A&B.

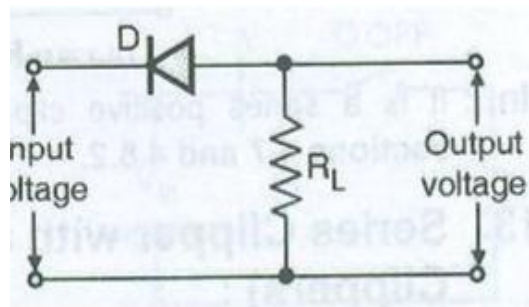5. Draw the Norton's Equivalent.
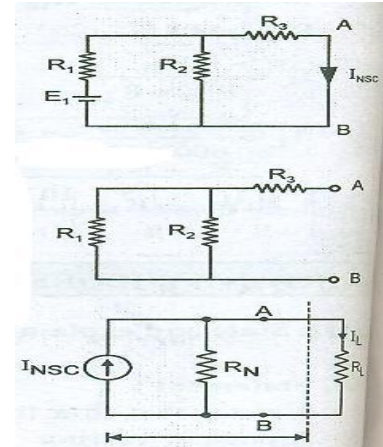
e) Draw the circuit diagram and input output waveforms for positive and negative clipping circuits.

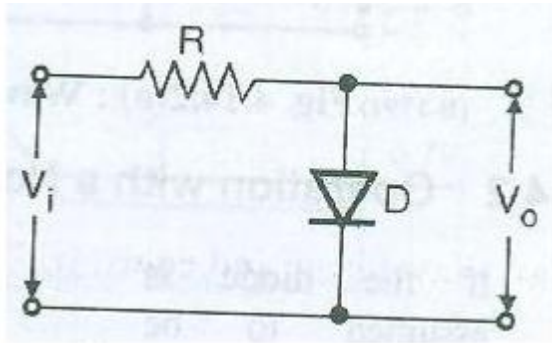Ans:- (Any circuit for series or shunt clipper may be considered- 1mks each for diagram and waveforms)
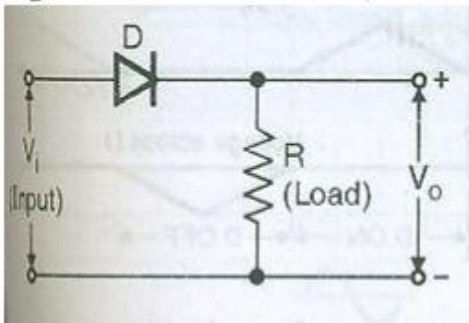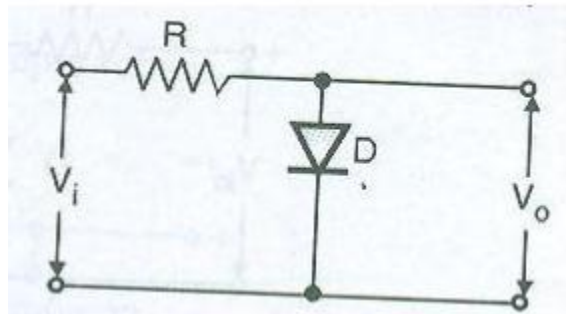

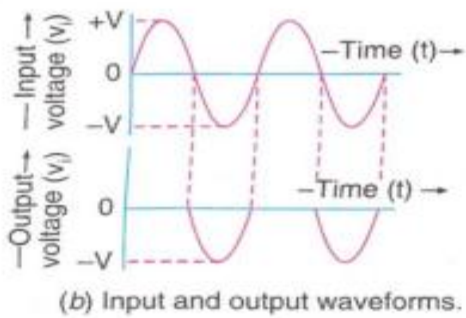Series Negative clipper   Series Positive clipper
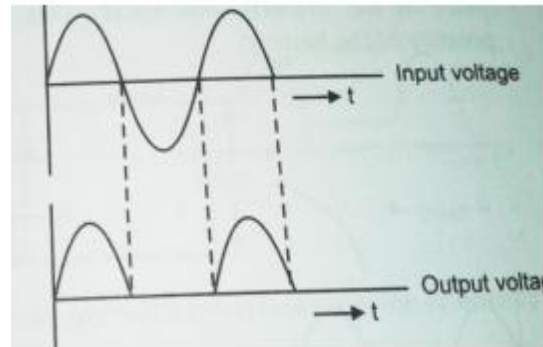
OR

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Shunt Positive clipper   Shunt Negative clipper

Waveforms

Positive Clipper   Negative Clipper

f) In a FWR, Vm=10 V,RL=10 kΩ,Calculate Vdc,Idc, Refer fig No 2
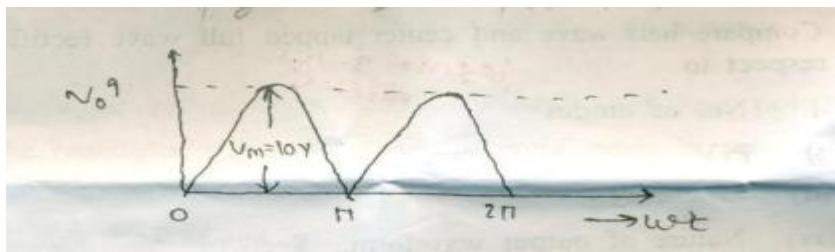
Ans:-

Given: $V_m = 10V$, $R_L = 10k\Omega$

To find: 1 V_{dc} 2. I_{dc}

   1. To calculate Idc :   (2M)

$I_{dc} = 2 I_m / \pi$

Where $I_m = V_m / R_S + R_F + R_L = 10 / 10000$ (Since, Assume R_S and $R_F = 0$)

Im = 1×10^{-3} A or 1 mA

Therefore, $I_{dc} = 2 \times 1 \times 10^{-3} / \pi = 6.36 \times 10^{-4}$ A = 636 μA ... Ans.

   2. To calculate Vdc :   (2M)

   $V_{dc} = I_{dc} \times R_L = 6.36 \times 10^{-4} \times 10000 = 6.36$ V ... Ans.

OR

$V_{dc} = 2 V_m / \pi = 2 \times 10 / \pi = 6.36$ V

Q.5 Attempt any FOUR of the following: **16**

a) Draw and explain the working of positive clamper circuit.

Ans: Diagram with waveform 2M and explanation 2M

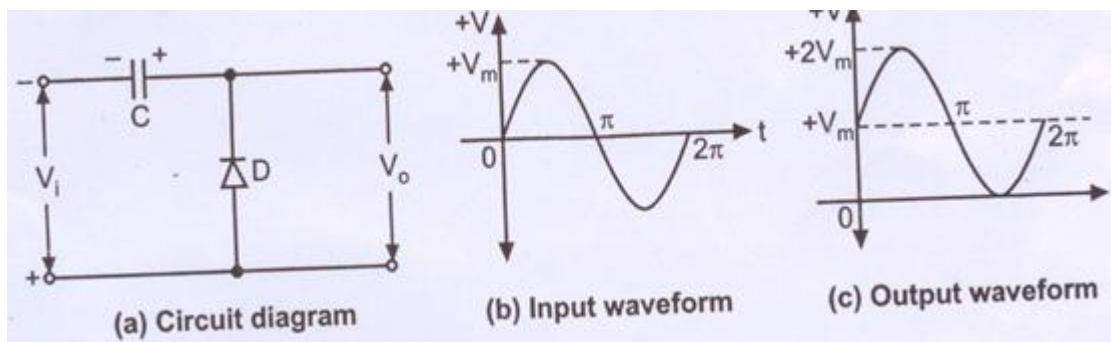Fig shows the circuit diagram of an unbiased positive diode clamper.

(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.

b) State the condition for RC integration. Draw the output waveform for square wave input.

Ans: Condition 2M and waveform 2M

The integrating circuit is designed in such a way that the resistance R is very large as compared to the value of reactance of a capacitor C.

$$R >> X_C$$

$$R >> 1/2\pi fc$$

Or $\qquad 2\pi RC >> 1/f$

$$2\pi RC >> T$$

Where,T- Time period of an input A.C . signal

$\tau >> T$ (since $\tau = RC$)

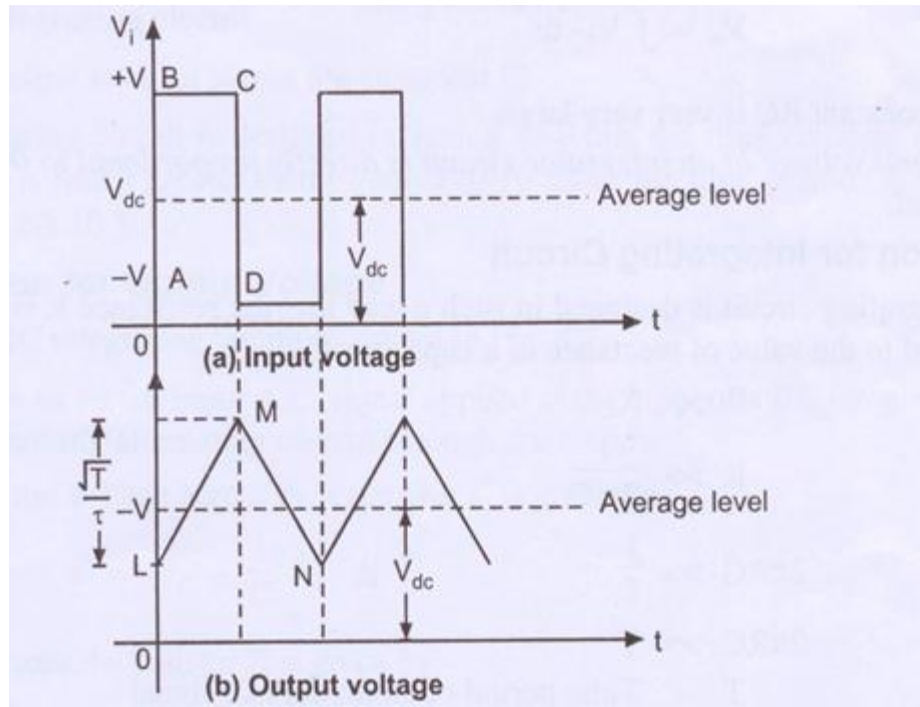Hence the time constant (τ) of the RC circuit should be greater than the time period T of the input A.C. signal.

For good integration the time constant τ of the RC circuit may be greater than or equal to 10 times the time period of the input A.C. signal.

Therefore $\tau \geq 10T$

In the integrating circuit, the average level of the output A.C. signal is the same as that of the input A.C. signal.
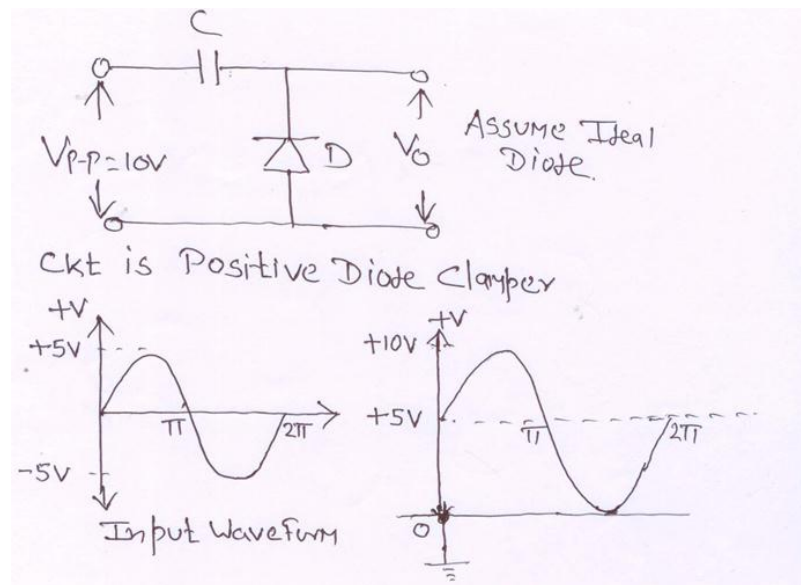

(a) Input voltage

(b) Output voltage

c) Identify the following circuit shown in Fig.No.3 and draw input and output waveforms.

Ans: Identification 2M and waveforms 2M

The following circuit is positive clamper circuit.

d) Describe the operating principle of PIN diode with neat sketch.

Ans: Operating principle 2M and Sketch 2M

Consider the structure of a PIN diode as shown in fig

    A PIN diode operates under what is known as high-level injection.In other words,the intrinsic "i" region is flooded with charge carries from the "P" and "N" regions.

   Its function can be likened to filling up a water bucket with a hole on the side.

Once the water reaches the hole's level it will begin to pour our water.Similarly,the diode will conduct the current once the flooded electrons and holes reach an equilibrium point,where the number of   electrons is equal to the number of holes in the intrinsic region.

When the diode is forward biased,the injected carrier concentration is typically several order of magni tude higher than intrinsic level carrier concentration.Due to this higher level injection,which in   is due to the depletion process,the electric field extension deeply (almost the entire length) into the region.

This electric field helps in speeding up of the transport of charge carriers from P to N region,which results in faster operation of the diode,making it a suitable device for high frequency operations.

(a) Construction of a PIN diode

(b) Symbol of PIN diode

Fig. 2.28 : PIN diode
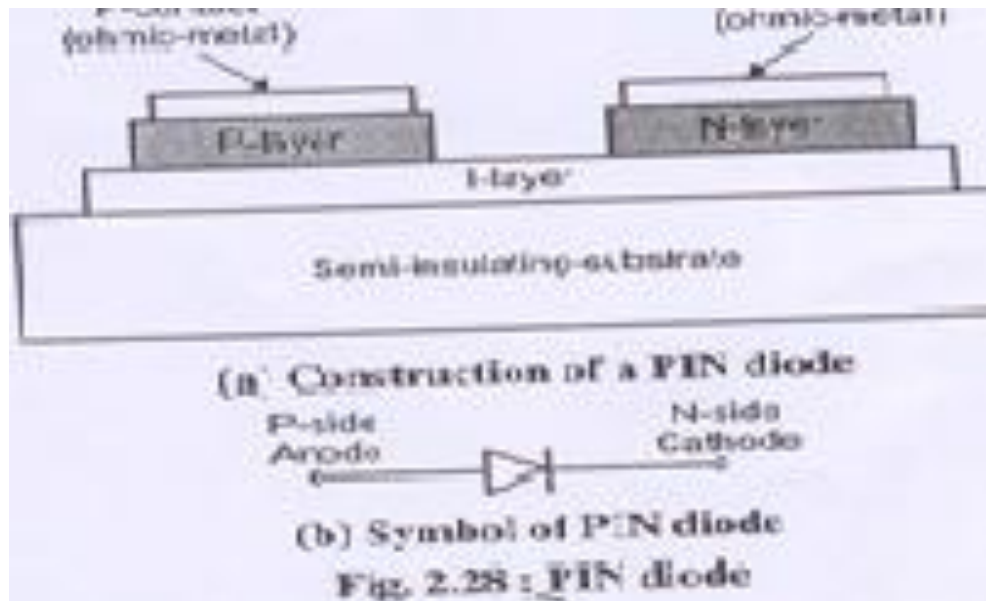
e) Define Bilateral and Linear network.

Ans: Each 2M

Bilateral network- If the magnitude of current flowing through a circuit element i s not affected when the polarity of the applied voltage is changed,then the element is known as a bilateral element.

The bilateral elements offer the same impedance in both directions.

A resistor is a bilateral element.

A network comprising of one or more number of bilateral elements is known as a bilateral network.

Linear network-If the resistance ,capacitance or inductance offered by the passive elements does not change with a change in the applied e.m.f or the circuit current,the element is called as a linear element.

The linear element shows a linear relation between voltage and current.

The network comprising of one or more linear number of elements is known as a linear network.

f) State Norton's theorem and draw the equivalent circuit.

Statement 2M and equivalent network 2M

Ans:Norton's theorem states that any complex linear network can be replaced by a parallel circuit consisting of an ideal current source and a resistance.
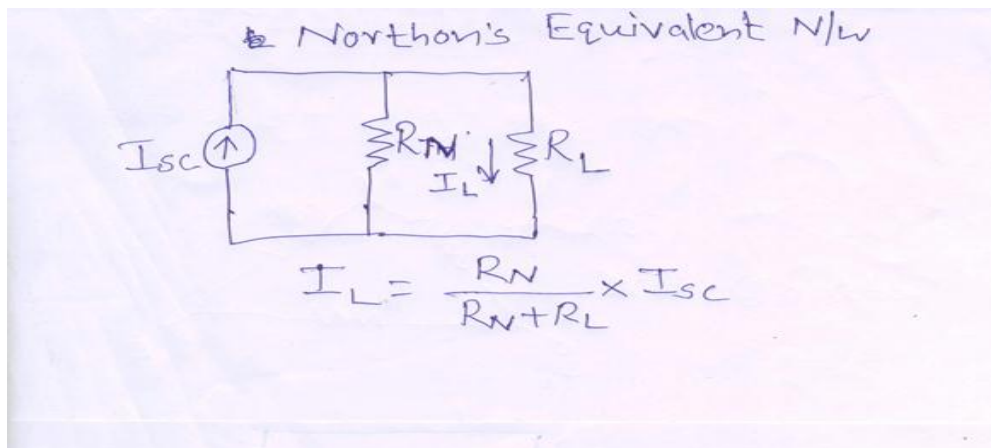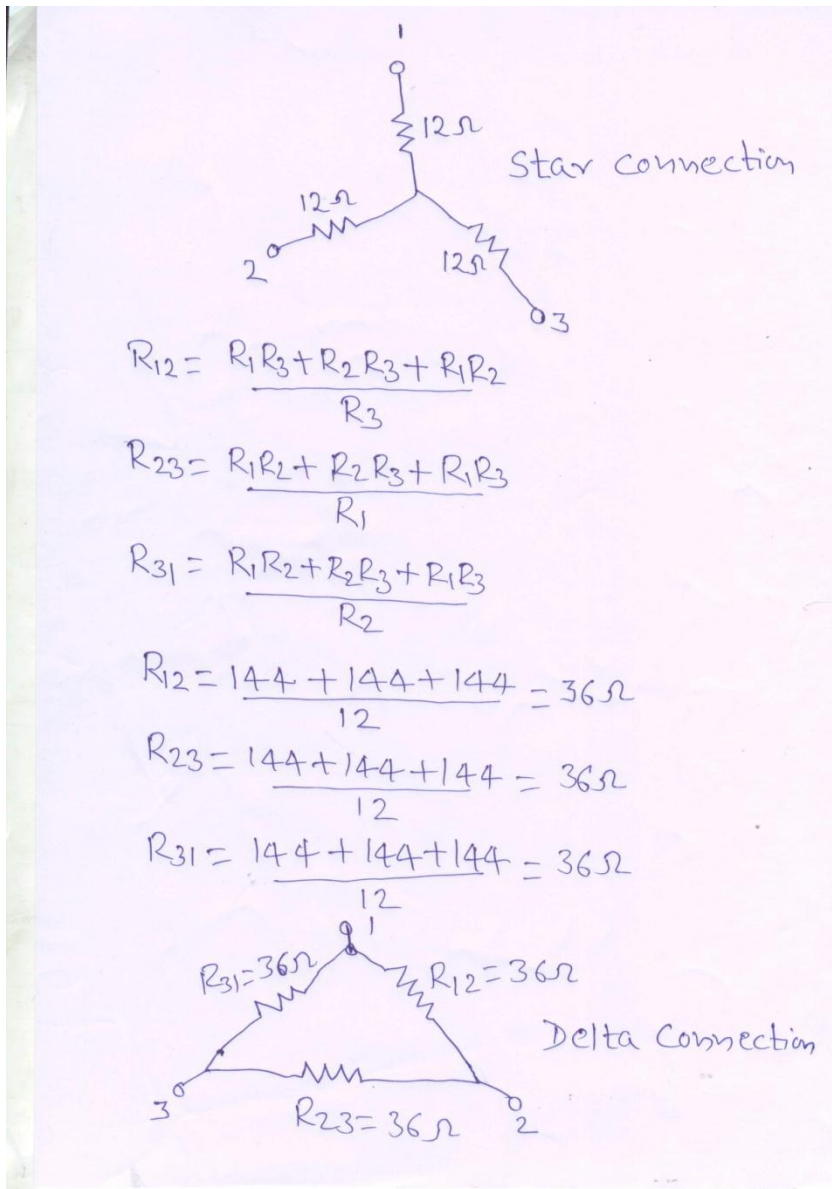
Q.6 Attempt any FOUR of the following:

Ans:- Formula 1M, circuit 1M and answer 2M

a) Three resistances each of 12ohms are connected in star.Convert it into equivalent delta connections

$$R_{12} = \frac{R_1 R_3 + R_2 R_3 + R_1 R_2}{R_3}$$

$$R_{23} = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1}$$

$$R_{31} = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_2}$$

$$R_{12} = \frac{144 + 144 + 144}{12} = 36\Omega$$

$$R_{23} = \frac{144 + 144 + 144}{12} = 36\Omega$$

$$R_{31} = \frac{144 + 144 + 144}{12} = 36\Omega$$

a.

b) State the working principle of LED and LASER diode.

Ans: Each 2M

LED
Working principle of LED diode:An LED emits two light when electrical energy is applied to it.LED is a two terminal device.The terminals are named as anode (A) and the other as cathode(K).
A PN junction is formed between the anode and cathode.So LED is basically a PN junction diode.
For proper operation,it is necessary to forward bias the LED as shown in fig and symbol of LED is also shown.This shows that the symbol is same as that of a PN junction diode with two arrows indicating that it emits light.

(a) LED biasing   (b) Circuit symbol of LED
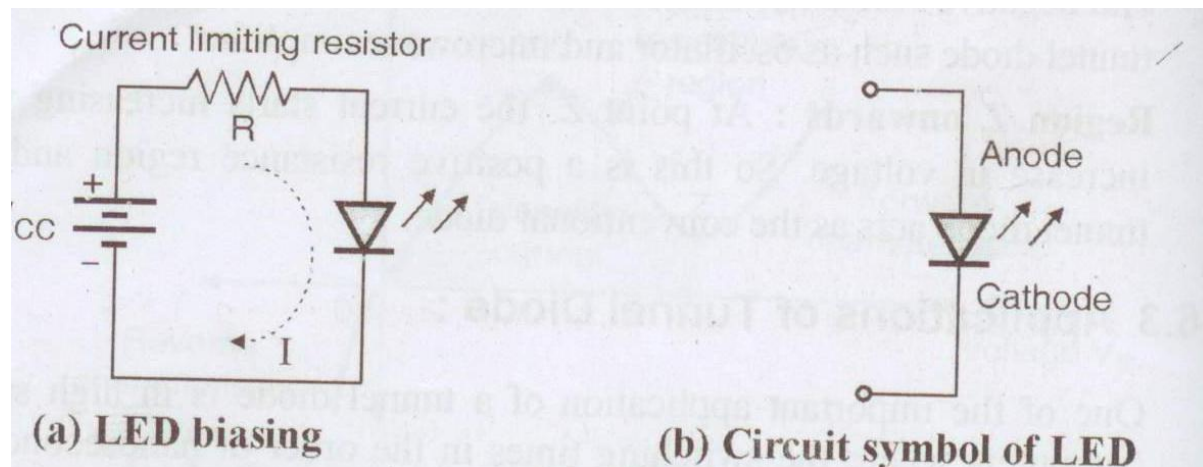
LASER

Working principle of LASER diode:There are three main processes in semiconductors that are associated with light:
1) Light absorption

2) Spontaneous emission

3) Stimulated emission

Stimulated emission is different. A light photon entering the semiconductor lattice will strike an electron and release energy in the form of another light photon.

☐The way in which this occurs releases this new photon of identical wavelength and phase. In this way the light that is generated is said to be coherent.

☐This type of process is the basic principle on which LASER Diode operates.

☐Photon, with energy equal to E2 – E1 interacts with an atom in upper energy state, causing it to return to lower energy state with the emission of a second photon.

☐Second photon has the same phase, frequency and polarization as the first.

☐It is stimulated emission which gives LASER special properties such as narrow spectral width and coherent output radiation.

c) For the circuit shown in Fig no.4,determine the value of RL when maximum power is drawn. Also find the value of maximum power.

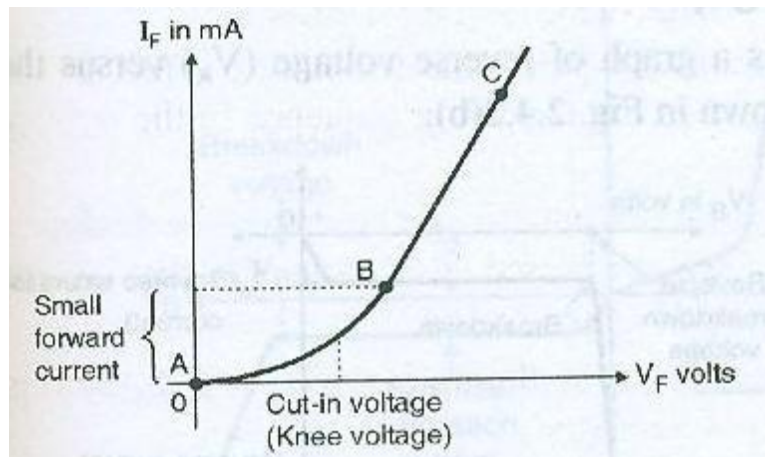Ans:- Value of RL 2M and maximum power 2M

For Max Power transfer theorem

$$R_{TH} = R_L$$

in the above ckt $R_{TH} = 25\Omega$

so $R_L = 25\Omega$

$$P_{Max} = \frac{V_{TH}^2}{4R_L} = \frac{(50)^2}{4 \times 25}$$

$$P_{Max} = \frac{2500}{100} = 25W$$

d) Draw and explain V-I characteristics of P-N junction diode.

Ans:- V-I characteristics 2M and explanation 2M

□The forward characteristics is the graph of the anode to cathode forward voltage VF versus the forward current through the diode (IF). The forward characteristics is divided into two portions, AB and BC . Region A to B of the forward characteristics.

The forward voltage is small and less than the cut in voltage. Therefore the forward current flowing through the diode is small. With further increase in the forward voltage, it reaches the level of the cut in voltage and the width the depletion region goes on decreasing.□**Region B to C:**
. As soon as the forward voltage equals the cut in voltage, current through the diode increase suddenly. The nature of this current is exponential. The large forward current in the region B-C of the forward characteristics is limited by connecting a resistor R in series with the diode. Forward current is of the order of a few mA.

 The forward current is a conventional current that flows from anode to cathode. Therefore it is considered to be a positive current, and the forward characteristics appears in the first quadrant.

Cut in voltage (Knee voltage):
 The voltage at which the forward diode current starts increasing rapidly is known as the cut in voltage of a diode. The cut in voltage is very close to the barrier potential. Cut in voltage is also called as knee voltage.

 Generally a diode is forward biased above the cut in voltage. The cut in voltage for a silicon diode is 0.7 V and that for a germanium diode is 0.3V.

Reverse characteristics of a Diode.
 Current flowing through a diode in the reverse biased state is the reverse saturation current which flows due to the minority carriers.

Therefore it is treated as a negative current. Hence the reverse characterisitcs appears equal to Io if the temperature is constant.

As the reverse voltage is increased, the reverse saturation current remains constant equal to 10 if the temperature is constant. This is because, reverse saturation current does not depend on reverse voltage but it depends only on temperature.

But as the reverse voltage reaches the breakdown voltage value. a large current flows through the diode, due to the reasons discussed earlier.
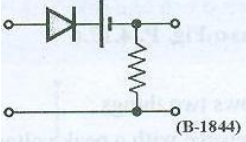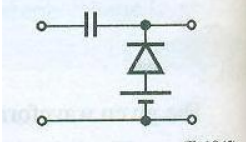
Thus we define the reverse breakdown voltage of a pn junction diode as the reverse voltage at which breakdown takes place and a large reverse current starts flowing through the diode.

Operation in the breakdown region should be avoided because the diode may be damaged due to excessive power dissipation.

Typically the reverse breakdown voltage for p-n junction diode is in range of 50 to 100 volts

e) Compare clipper and clamper(four points).

As:- Each point 1M

Sr. No	Parameter	Clipper	Clamper
1	Components used	Diode, Resistors	Diode, Capacitors, Resistors
2	Function	To remove a part of input waveform	To add a DC shift to the input waveform
3	Frequency of input	Not important as capacitor is not used	The value of C needs to be chosen on the basis of input frequency
4	Application	Diode clamp, wave shaping circuit	Voltage Multipliers
5.	Configuration	(B-1844)	(B-1845)

f) Determine current IL for network shown in Fig.No.5 using Thevenin's theorem.

Ans:- Value of V(OC) 1M ,value of Rth 1M,equivalent circuit 1M and value of current 1M.