WINTER– 16 EXAMINATION

Model Answer Subject Code: 17215

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model 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 judgement 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: **20 marks**

a) Define permeability and reluctivity of magnetic material.

Ans:- (Each definition – 1 mks)

- Permeability is the capability of a specific material to allow the flow of magnetic flux more easily. Thus higher permeability enables a material to pass more magnetic flux.
- Reluctivity is equal to the ratio of the intensity of the magnetic field to the magnetic induction of the material.

b) State Faraday's law of electromagnetic induction.

Ans:- (Each definition – 1 mks)

- **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 any four dielectric materials used for manufacturing capacitors.

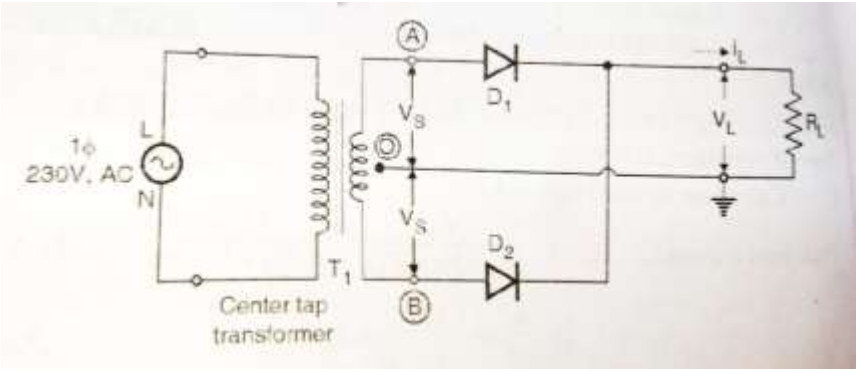
Ans: (any four materials - 1/2 mks each)

Dielectric materials used for capacitors:

1) Air
2) Vacuum
3) Glass
4) Oxide film
5) PVC
6) Titanate ceramic
7) Paper
8) Plastic
9) Mica

d) Draw circuit diagram of center-tap full wave rectifier and label it.

Ans: **(proper labelled diagram- 2 mks)**



e) Enlist different types of filters(any four)

Ans: **(each 1/2 mks)**

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.

f) State maximum power transfer theorem.

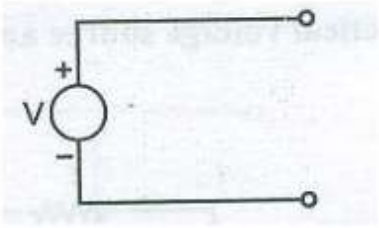
Ans: (proper relevant statement 2 mks)

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

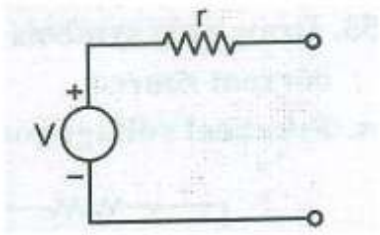
ie $R_L=R_{TH}$

g) Draw ideal voltage source and practical voltage source.

Ans: (each diagram - 1 mks)

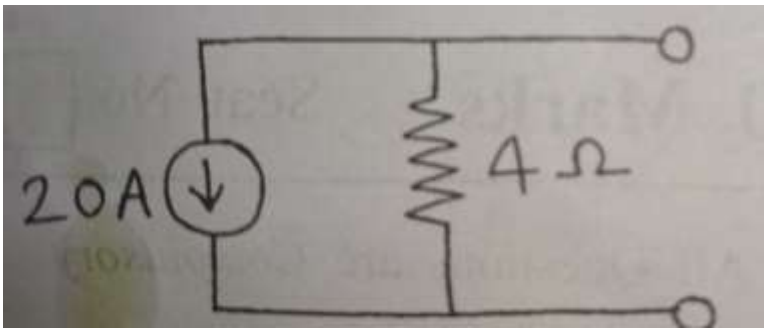


Ideal Voltage Source

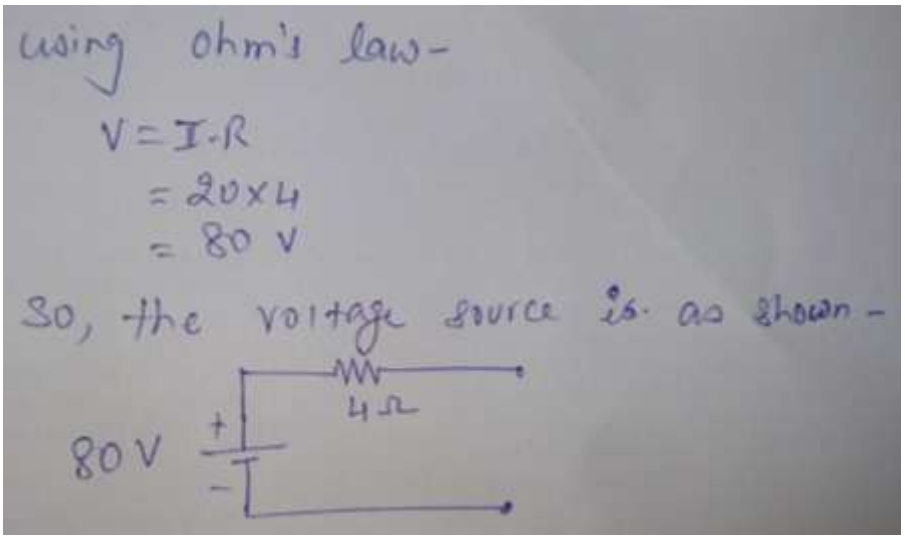


Practical Voltage Source

h) Convert following current source to its equivalent voltage source refer fig:

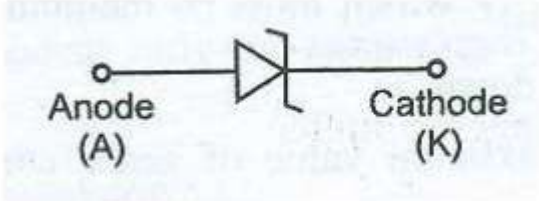


Ans:-(Correct conversion and diagram- 2 mks)

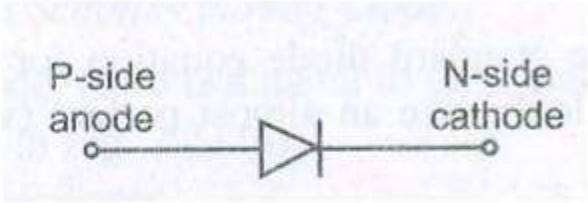


i) Draw symbols of Zener diode and PIN Diode.

Ans: (Each proper symbol - 1 mks)



Zener diode



PIN diode

j) State any two applications of schottky diode.

Ans: (Any 2 applications- 2 mks)

Applications of schottky diode:

1. Switching Mode Power Supply
2. AC to DC converters
3. Radar system
4. Schottky TTL logic for computers
5. Mixers and detectors in communication equipments

k) What is the need of wave-shaping circuit? State its types (any four).

Ans: (need -1 mks, any four types – 1 mks)

Need of waveshapping circuit :

1. To limit the voltage level of the waveform to some preset value.
2. To shift the waveform to a particular voltage level.
3. To generate one wave from the other.
4. To cut the negative and positive portions of the waveforms.

Types of wave-shaping circuit :

1. Clipper
2. Clamper
3. Integrator
4. Differentiator

l) Draw circuit diagram of RC differentiator.

Ans: (proper diagram – 2 mks)

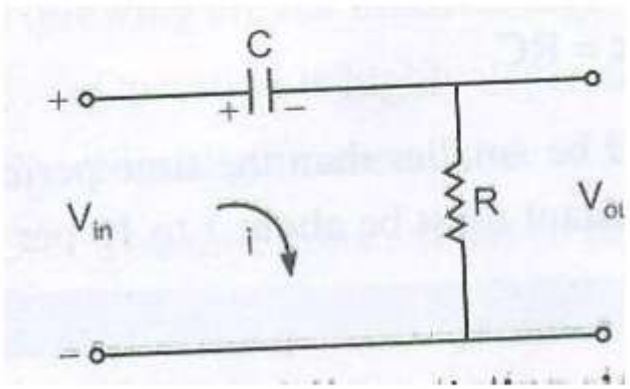


Fig: RC differentiating circuit

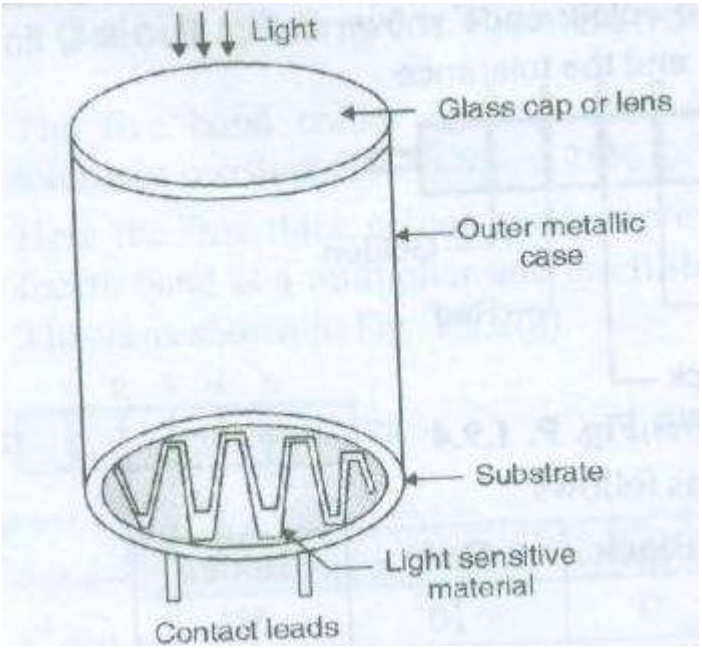
2) Attempt any Four Of the following: 16 marks

a) With the help of constructional diagram explain working of LDR with neat sketch.

Ans:**(Diagram – 2 marks, working – 2 mark)**

Working:-

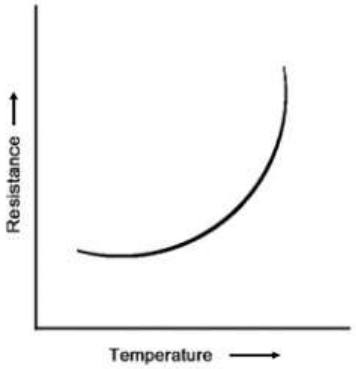
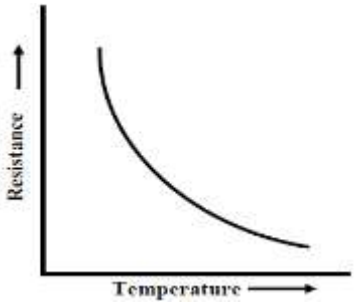
Due to the radiant energy supplied to the semiconductor, the covalent bonds are broken and the electron hole pairs are generated.These increased current increase the conductivity of the material and hence decrease the resistivity. Such a device is called as a photoresistor or photoconductor.The photoconductive cell or a light dependent resistor (LDR) makes use of the principle of photoconductivity.It is semiconductor device in which resistance is dependent on the intensity of incident light. The resistance of the LDR will decrease with increase in the intensity of incident light.



b) Compare PTC and NTC thermistors w.r.t.

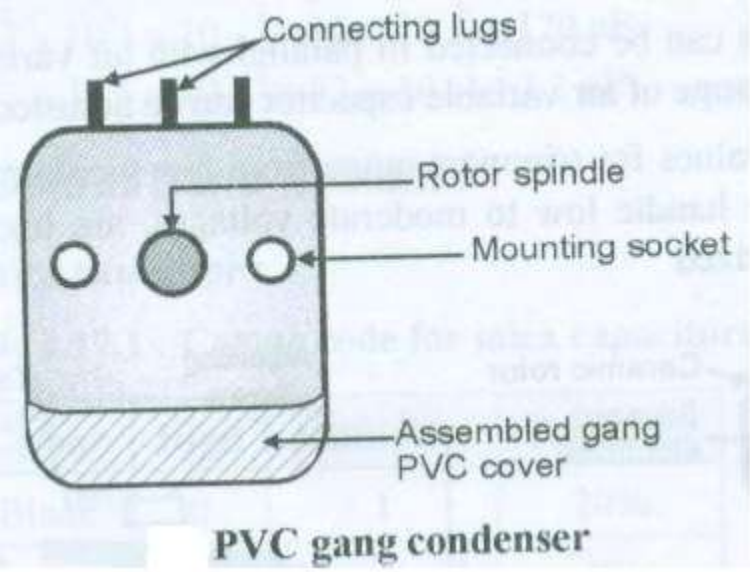
i) Materials used
ii) Characteristics
iii) Temperature coefficient
iv) Application

Ans: (Each point - 1 mks)

	PTC	NTC
Materials used	Barium titanate, titanium oxide, powdered barium carbonate	Manganese, nickel, cobalt, titanium
Characteristics		
Temperature coefficient	60°C to 180°C	+200°C to +1000°C
Application (any 1)	1) Temperature sensing in electric motors and transformers for protection. 2) Liquid level sensor 3) To protect solid state fuse against excess current	1) For temperature measurement and control 2) Temperature compensation 3) Fluid flow measurement

c) Describe PVC gang capacitor with neat diagram.

Ans: (diagram – 2 mks, explanation – 2 mks)



PVC gang condenser

Description-

In plastic core capacitor, poly-vinyl chloride (PVC) type of plastic film is used as dielectric between the fixed & movable vanes instead of air. This increases the dielectric constant of the capacitor & results in great reduction of size of capacitor in comparison with the air core capacitor.

d) Enlist any four specifications of capacitor.

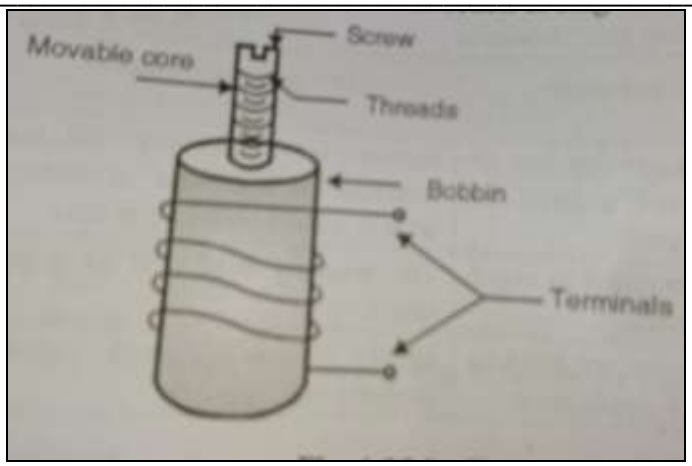
Ans: (any four specifications- 1 mks each)

Four specifications of capacitor are:

i. Working voltage
ii. Capacitive reactance
iii. Dissipation factor
iv. Frequency characteristics
v. Equivalent series resistance
vi. Quality Factor
vii. Tolerance

e) Describe working of slug tuned inductor with neat sketch.

Ans: (diagram – 2 mks, working -2 mks)



Working:-

The construction of slug-tuned coil is similar to the ferrite core coil, but the core is adjustable.

The form is made of plastic, phenolic, fiberglass, nylon or ceramic materials and is internally threaded.

The windings of the coil are wound on to the form.

The tuning slug is a ferrite or powdered iron coil core that mater with the internal threads in the coil form. A screwdriver slot or hex hole in either (or both) ends allow you to adjust it.

The inductance of the coil depends on how much of the core is inside the coil windings.

The permeability of the core will increase or decrease the inductance according to how much of the core is inside the coil.

If the core is made with either a hexagonal hole or screwdriver slot, then the inductance of the coil can be adjusted by moving the core in or out of the coil. These coils are called slug-tuned inductor.

f) Define following w.r.t. PN junction diode:

i) Knee voltage

ii) Breakdown

iii) Static resistance

iv) Dynamic resistance

Ans:

Note: Formulas are optional.

Knee voltage/cutin voltage-

Cut-in voltage **(1 Mark)**

It is the minimum voltage at which current through diode start increasing rapidly. It is also known as knee voltage.

Static resistance **(1 Mark)**

The ratio of d.c. voltage across the diode to the d.c. current flowing through it is called static resistance.

$$R_F = V_F / I_F$$

Dynamic resistance **(1 Mark)**

The resistance offered by the diode to an a.c. signal is called its dynamic resistance.

$r_{ac} = 1 / \Delta I_F / \Delta V_F = \Delta V_F / \Delta I_F$

= Change in voltage / Resulting change in current.

Breakdown voltage **(1 Mark)**

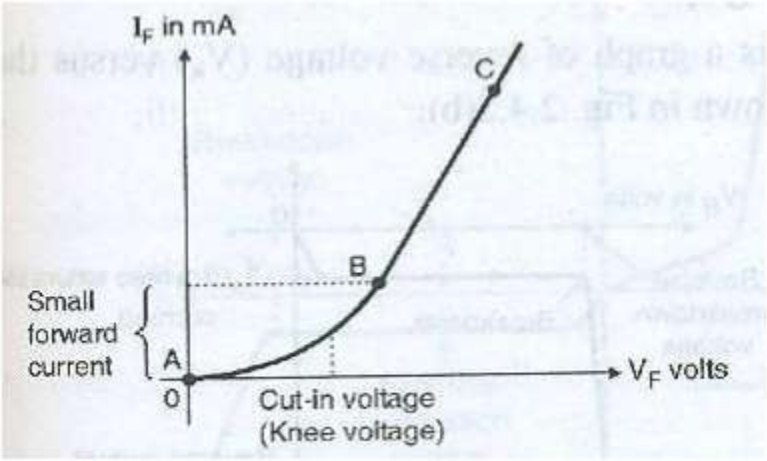
The voltage, at which the abrupt increase in reverse current through the PN junction occurs, is known as breakdown voltage.

Q 3. Attempt any FOUR of the following: 16

a) Describe working of PN junction diode with the help of its VI characteristics.

Ans: (V-I char. – 1 mk , description – 1 mk each)- Forward Characteristic

V-I char. – 1 mk , description – 1 mk each)- Reverse Characteristic



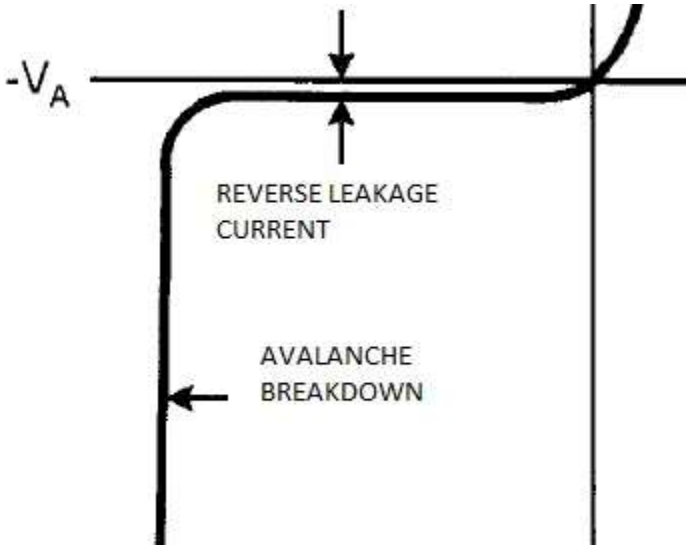
The forward characteristics is the graph of the anode to cathode forward voltage VF versus the forward current through the diode (IF). The forward characteristics is divided into two portions, AB and BC . Region A to B of the forward characteristics.

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.

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.

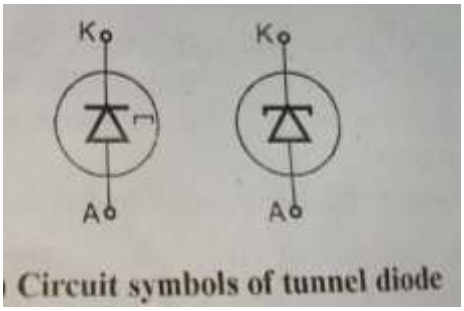
Thus we define the reverse breakdown voltage of a pn junction diode as the reverse voltage at which breakdown takes place and a large reverse current starts flowing through the diode.

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

b) Explain operations of tunnel diode along with its symbol and characteristics.

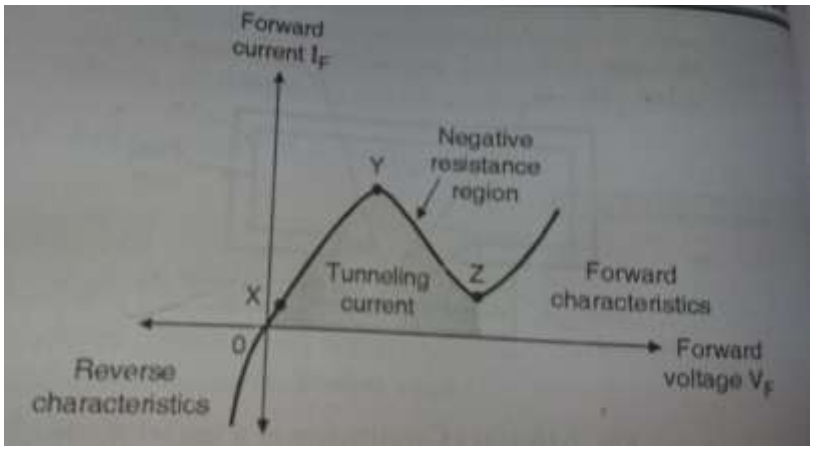
Ans: (symbol-1 mks, characteristics- 1 mks, operation- 2 mks)



Circuit symbols of tunnel diode

(any 1 symbol)

Characteristics



Operation-

Forward characteristics :

1. Forward characteristics can be divided into three regions namely X to Y, Y to Z and Z onwards.
2. **Region X to Y :** In this region the forward voltage V_F is extremely small. But heavy conduction will take place in this region because electrons "tunnel" through the pn junction. The "tunnelling" takes place as a result of heavy doping.
3. **Region Y to Z :** In this region, at point Y the forward voltage begins to develop a barrier and the forward current starts decreasing inspite of continued increase in V_F. This region is called as the **negative resistance region**.
4. The diode resistance in the region Y to Z is mathematically expressed as.

$$R_F = \frac{\Delta V_F}{\Delta I_F} \quad \ldots(2.16)$$

ΔV_F is positive but ΔI_F is negative. Hence R_F is called as a negative resistance. The decrease in I_F with increase in V_F is opposite to the Ohm's law.

The negative resistance characteristics is utilized in the applications of tunnel diode such as oscillator and microwave amplifier.

5. **Region Z onwards :** At point Z, the current starts increasing with increase in voltage. So this is a positive resistance region and the tunnel diode acts as the conventional diode.

Reverse characteristics :

1. Due to heavy doping of p and n sides, the depletion region is extremely narrow when the tunnel diode is reverse biased.
2. Therefore the reverse blocking capacity of the junction is lost and reverse current will start flowing as soon as a very small reverse voltage is applied.
3. Thus the tunnel diode allows the conduction to take place for all the reverse voltages. There is no breakdown effect as observed in the conventional rectifier diode.
4. Therefore we can not use the tunnel diode as a rectifier.

c) State the meaning of avalanche breakdown and zener breakdown. Explain it.

Ans:

Avalanche breakdown **(1 ½ Marks)**

The increased reverse voltage increases the amount of energy impaled to minority carriers, as they diffuse across the function.

As the reverse voltage is increased further the minority carriers acquire a large amount of energy.

When these carriers collide with atoms, within the crystal structure they impact sufficient energy to break a covalent bond and generate additional carriers (electron hole pairs).

These additional carriers pick up energy from the applied voltage and generate more carriers, and reverse current increased rapidly.

This cumulative process of carrier generation (or multiplication) is known as Avalanche breakdown.

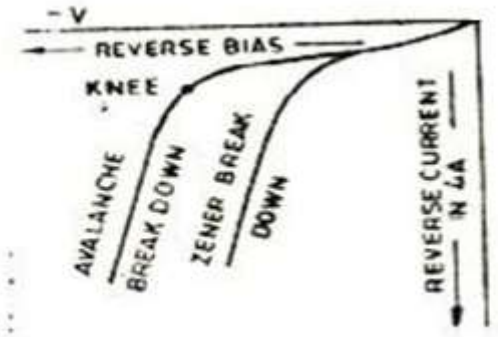
Zener Breakdown **(1 ½ Marks)**

It occurs when diode is heavily doped. Due to heavy doping, depletion layer is narrow.

When the reverse voltage across the diode is increased, electric field is developed across depletion layer.

Electric field is strong enough to generate large number of electron-hole pair by breaking covalent bonds.

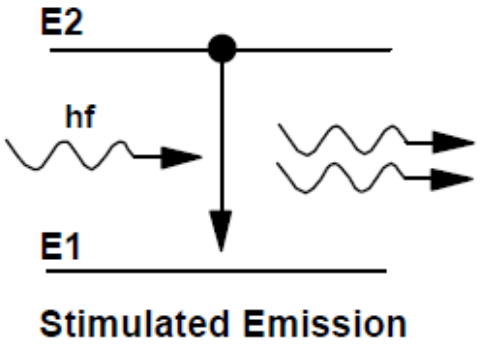
Because of large number of these carriers reverse current increases sharply and breakdown occurs which is known as Zener Breakdown.



(1 Mark)

d) Describe operating principle of LASER diode with neat sketch.

Ans:(diagram- 2 mks, operation -2 mks)



Stimulated Emission

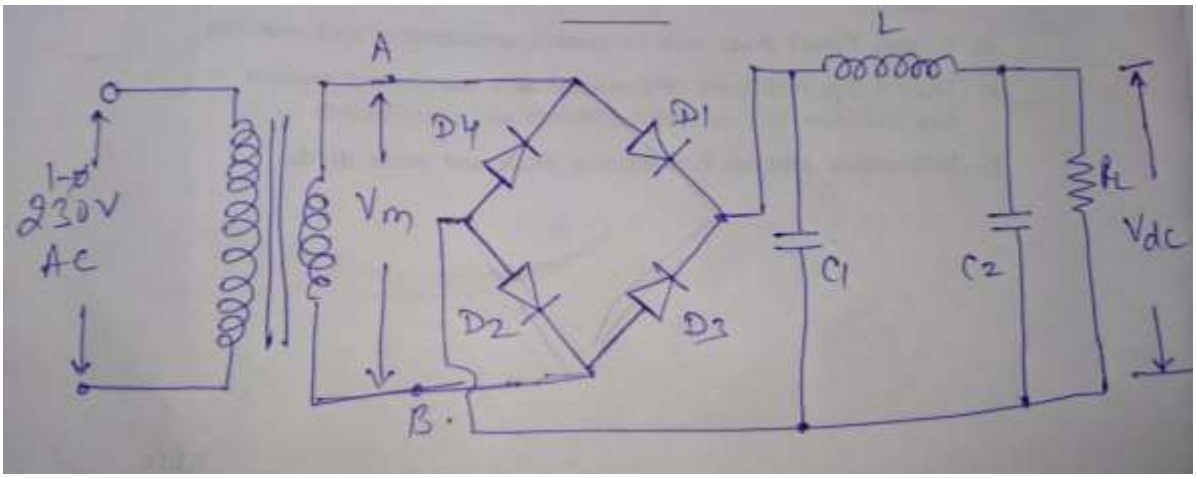
There are three main processes in semiconductors that are associated with light:

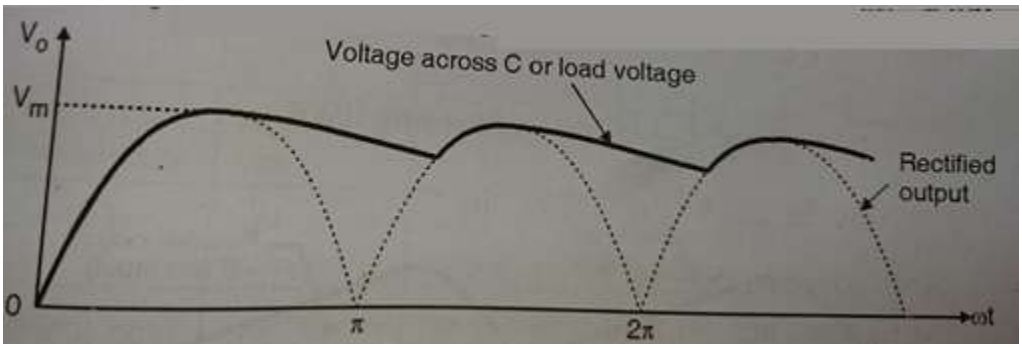
- Light absorption
- Spontaneous emission
- Stimulated emission

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 $E_2 – E_1$ 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.t is stimulated emission which gives LASER special properties such as narrow spectral width and coherent output radiation.

e) Draw the circuit diagram of bridge rectifier with π filter. Draw its input and output waveforms.

Ans: (diagram- 2 mks, waveforms – 2 mks)





f) Define following w.r.t rectifier:

I. PIV
II. Ripple Factor
III. Efficiency
IV. TUF

Ans:- (each definition- 1 mks)

PIV: Peak Inverse Voltage (PIV) is defined as the maximum negative voltage which appears across non-conducting reverse biased diode.

TUF : Transformer Utilization Factor (TUF) is defined as the ratio of DC output power to the AC power ratings of the transformer.Mathematically it is expressed as,

$$\text{TUF} = \frac{\text{DC output power}}{\text{AC power ratings of the transformer}}$$

Ripple Factor: Ripple Factor is defined as the ratio of RMS value of the AC component of output to the DC or average value of the output. Mathematically it is expressed as,

$$\text{Ripple Factor} = \frac{\text{RMS value of the AC component of output}}{\text{DC or average value of the output}}$$

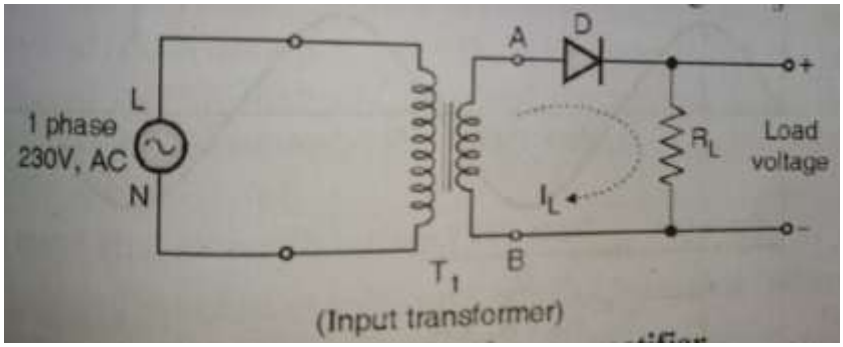
Efficiency of rectifier: The ratio of DC o/p power to the AC i/p power is called as efficiency and given as-

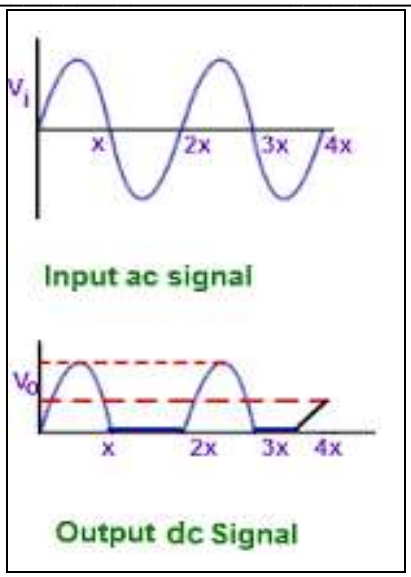
η = DC output power/ AC input power = P_{Ldc} / P_{ac}

Q4. Attempt any FOUR of the following: 16 marks

a) Describe working of half wave rectifier with the help of circuit diagram and waveforms.

Ans:(diagram- 2 mks, waveforms- 1 mks, working- 1 mks)





Working :

In the positive half cycle (0 - π) of the ac supply, the secondary voltage V_{AB} is positive. i.e. A is positive with respect to B. Hence the diode is forward biased and starts conducting. As the diode starts conducting, the secondary voltage V_{AB} appears almost as it is across the load resistance (as the voltage drop across a conducting diode is very small). The load voltage is thus positive and almost equal to the instantaneous secondary voltage V_{AB}.

In the negative half cycle (π - 2π) of the ac supply, the secondary voltage V_{AB} is negative. i.e. A is negative with respect to B. Hence the diode is reverse biased and offers a very high resistance. Hence we can replace it by an open circuited switch. The load is disconnected from the secondary. Hence the load voltage and load current both are zero and the voltage across the diode is equal to the instantaneous secondary voltage V_{AB}.

b) Calculate value of capacitor if following is printed on body of capacitors:

I. 103

II. 3k3

Ans:- (each proper answer -2 mks)

I. $103 = (10 \times 10^3) \times 10^{-12} = 10 \times 10^{-9} = 10$ nF

II. $3k3 = 3.3\ k = (3.3 \times 10^3) \times 10^{-12} = 3.3 \times 10^{-9} = 3.3$nF

C) Compare HWR and FWR w.r.t

I. PIV

II. Ripple frequency

III. Average output voltage

IV. Efficiency

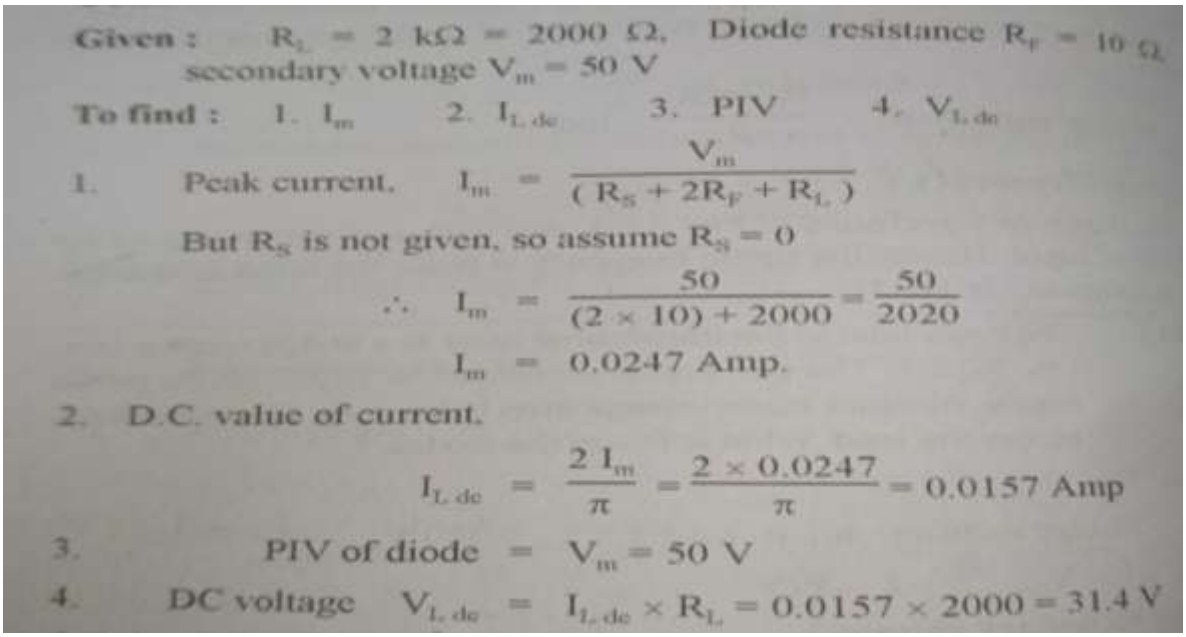
Ans:- (relevant comparison- 4 mks Note- FWR can be bridge or centre tapped rectifier)

Parameters	HWR	FWR (Centre tap)
PIV	Vm	2Vm
Ripple frequency	F_{in} (or) 50Hz	2 F_{in} (or) 100Hz
Average output voltage	Vm /π	2Vm /π
Efficiency	40.6%	81.2%

d) In bridge rectifier load resistance R_L=2KΩ. The diode has forward dynamic resistance of 10Ω. The AC voltage across the secondary winding of transformer is V= 50 sin 314tV.Determine:

I. Peak current Im
II. DC value of current Idc
III. PIV of diode
IV. DC voltage Vdc

Ans:(each proper formula and calculation- 1/2 mks each)



Given : R_s = 2 kΩ = 2000 Ω, Diode resistance R_F = 10 Ω, secondary voltage V_m = 50 V

To find : 1. I_m 2. $I_{L\,dc}$ 3. PIV 4. $V_{L\,dc}$

1. Peak current, $I_m = \frac{V_m}{(R_S + 2R_F + R_L)}$

But R_S is not given, so assume $R_S = 0$

$\therefore I_m = \frac{50}{(2 \times 10) + 2000} = \frac{50}{2020}$

I_m = 0.0247 Amp.

2. D.C. value of current.

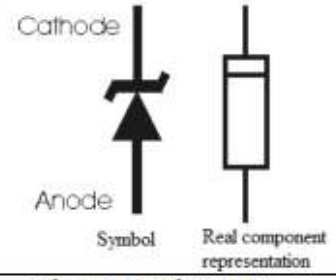
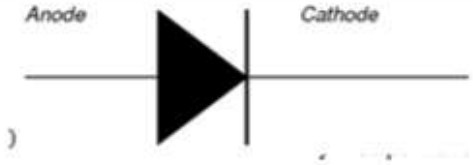
$I_{L\,dc} = \frac{2\,I_m}{\pi} = \frac{2 \times 0.0247}{\pi}$ = 0.0157 Amp

3. PIV of diode = V_m = 50 V

4. DC voltage $V_{L\,dc} = I_{L\,dc} \times R_L = 0.0157 \times 2000 = 31.4$ V

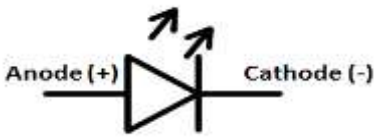
e) Compare PN junction diode and zener diode (any four points)

Ans:- (any 4 comprarison- 4 mks)

PARAMETER	ZENER DIODE	P-N JUNCTION DIODE
Conduction	Zener diode can conduct current in both direction.(i.e. forward as well as reverse)	P-N junction diode can conduct current only in forward direction.
Type of breakdown	Zener breakdown	Avalanche breakdown
Symbol		
Applications	As a voltage regulator, In waveshaping circuits etc.	In rectifiers, Waveshaping circuits etc.

g) Compare LED and photodiode (four points)

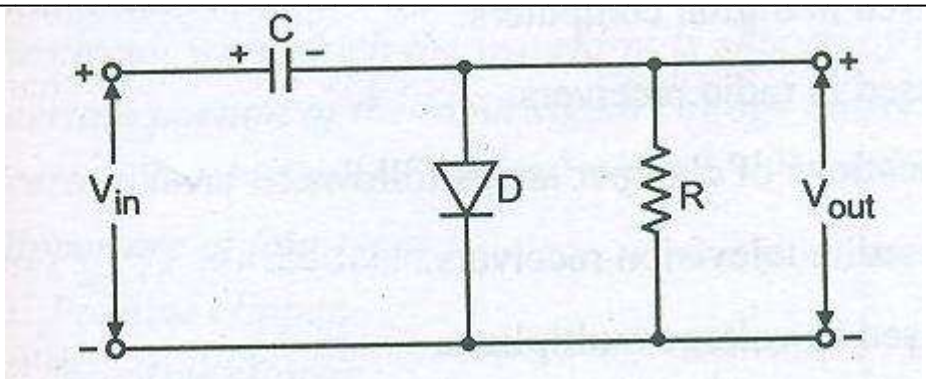
Ans:(any 4 comprarison- 4 mks)

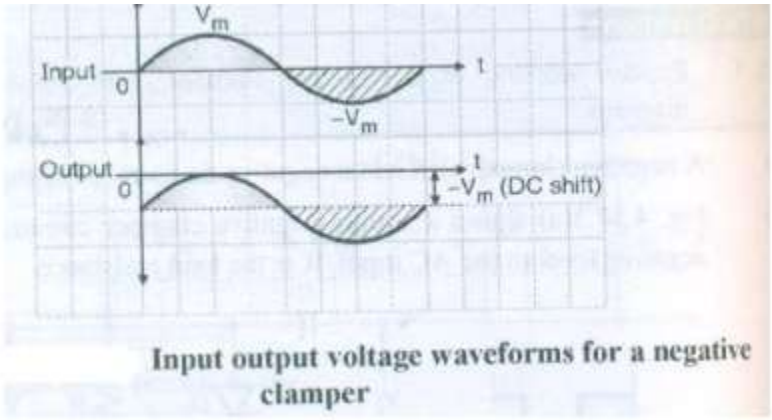
	LED	Photodiode
Symbol		
Normal region of operation	Operated in forward biased condition	Operated in reverse biased condition
Operation	When excited by external power supply photons are emitted in the form of light	When exposed to light, electron hole pairs are generated resulting in current flow
Application-any one	• In the optocouplers • In the infrared remote controls • As indicators in various electronic circuits • In seven segment and alphanumeric displays	• In the cameras for sensing the light intensity • In CD players • As photo(light) detector • In the fiber optic reveiver

5. Attempt any Four Of the following: 16 marks

a) Describe working of negative clamper circuit with neat diagram and waveform.

Ans :- (diagram- 2 mks, waveforms- 1 mks , working – 1 mks)





Input output voltage waveforms for a negative clamper

Operation-

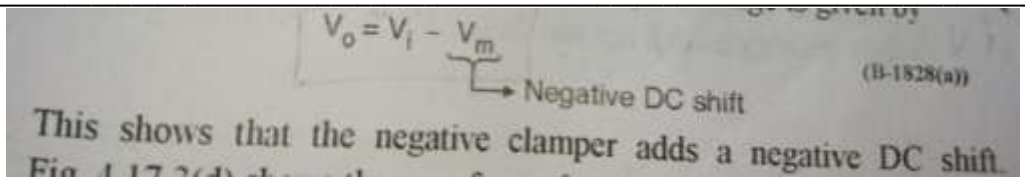
In the first positive half cycle the capacitor will charge through the forward biased diode to peak voltage V_m circuit

The charging takes place very quickly as the diode resistance is negligibly small.

Once the capacitor charges to "V_m", the diode is reverse biased and stops conducting.

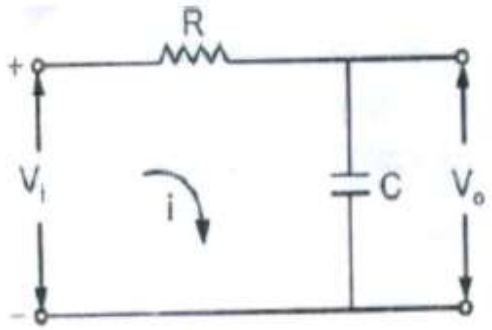
Fig. 4.17.3(c) shows the equivalent circuit for all the subsequent positive and negative half cycles. The diode is reverse biased. So remains off.

The expression for output voltage is



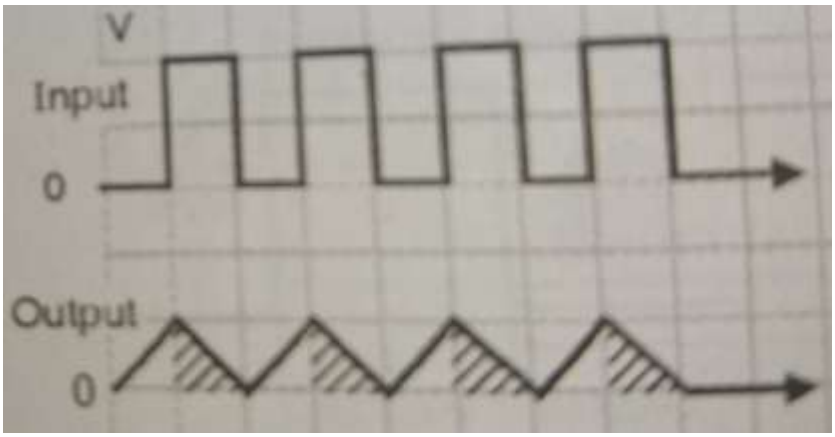
b) Draw circuit diagram of RC integrator .Draw its input and output waveform for square wave and triangle wave inputs.

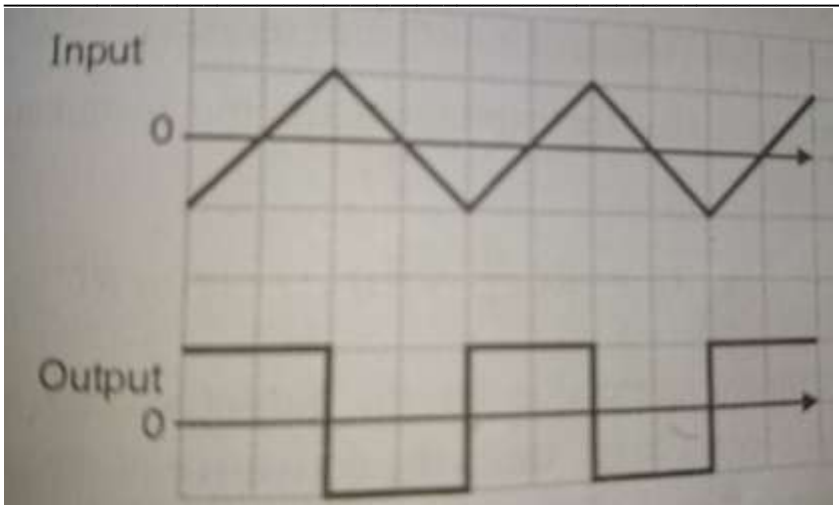
Ans:- (diagram- 2 mks, the waveforms – 1 mks each)



$$V_o \propto \int V_i \cdot dt$$

Waveforms-





c) Define:

i) Active network

ii) Passive network

iii) Linear network

iv) Unilateral network

Ans:(each definition- 1 mks)

i) **Active Network** : **(1M)**

If a network consists of any energy source, then it is called as an active network. The type of energy source can be a voltage source or a current source.

ii) **Linear Network** : **(1M)**

If the characteristics, parameters such as resistance, capacitances, inductances etc. remain constant irrespective of changes in temperature, time, voltage etc. then the circuit or network is called as a linear network.

iii) **Bilateral Network** : **(1M)**

It is the network whose characteristics or response does not depend on the direction of current through the various elements in it. Resistive networks are bilateral type.

iv) **Unilateral Network** : **(1M)**

It the characteristics, response or behavior of a network is dependent on the direction of current through its elements in it, then the network is called as a unilateral network. The networks containing elements such as diodes, transistors etc. are unilateral networks.

d) Find output of the circuit shown in fig. No. 2 (Refer Fig No. 2)

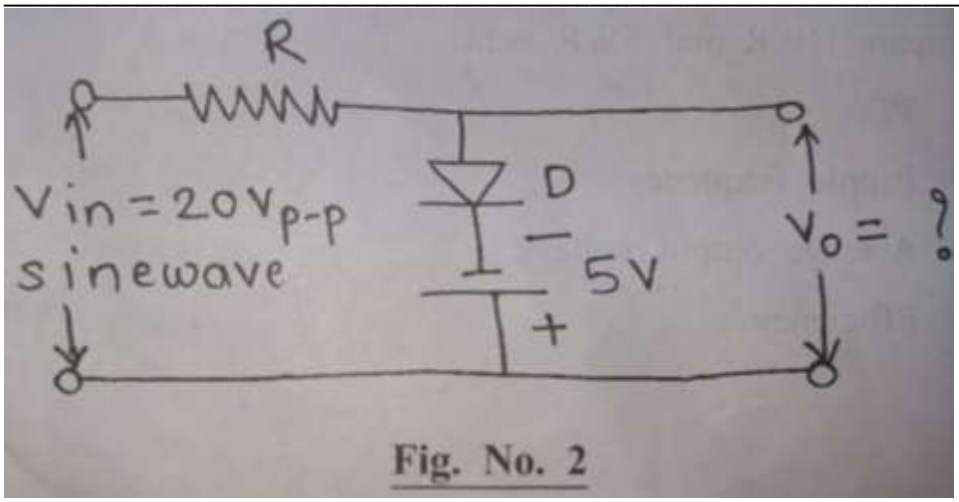
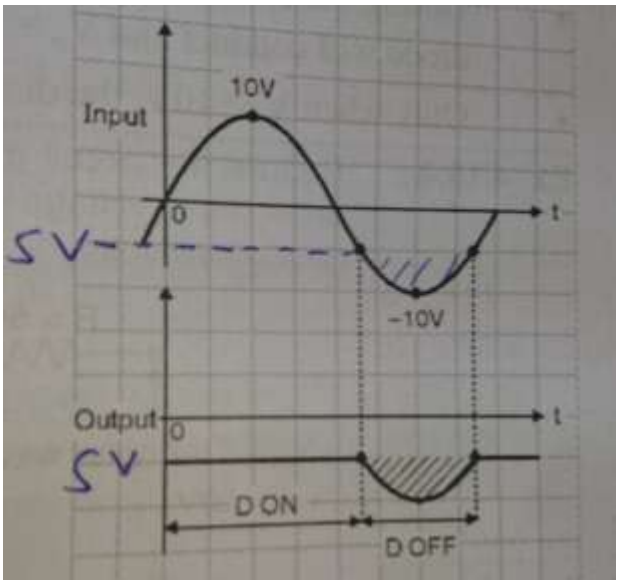


Fig. No. 2

Ans:(proper waveforms- 4 mks)



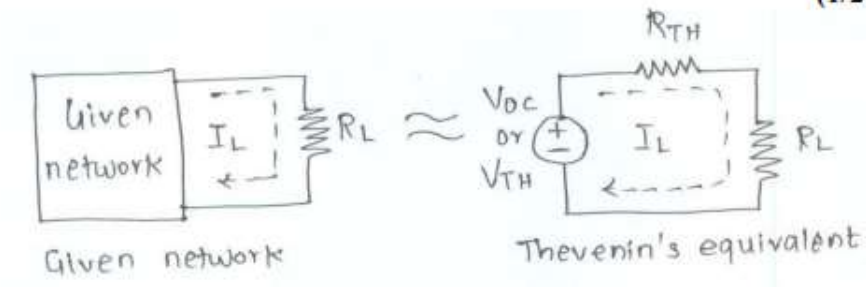
e)State Thevenien's theorem with suitable example .

Ans:

Statement **(1 Mark)**

Any network containing active and/or passive elements and one or more dependent and/or independent voltage/or current sources can be replaced by an equivalent network containing a voltage source (Thevenien's equivalent voltage V_{TH} or V_{OC}) and a series resistance (called Thevenien's equivalent resistance R_{TH})

Diagram **(1/2 Mark)**



Explanation **(1 Mark)**

Figures below illustrate the concept explained in the Thevenien's theorem. Figure shows the given network with a load resistance R_L connected between points A and B. the load current is I_L.

Figure shows that the given network is replaced by its Thevenien's equivalent which contains a voltage source V_{OC} or V_{TH} and a Thevenien's equivalent resistance R_{TH}.

V_{OC} or V_{TH} – this voltage is called as open circuit voltage or Thevenien's voltage and it a voltage between the open circuited load terminals as shown in figure.

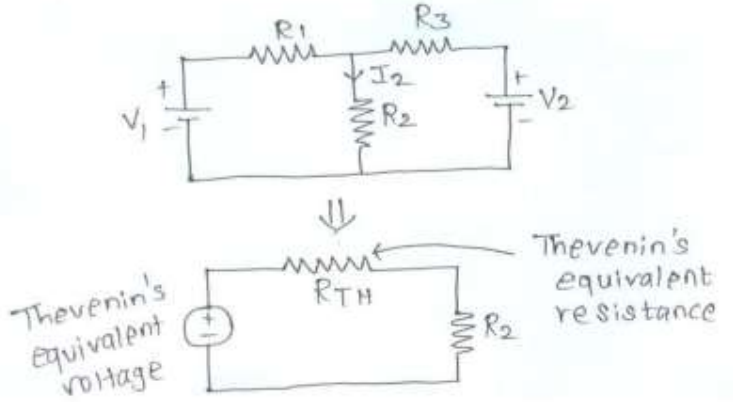
So, $V_{OC} = V_{TH} = V_{AB}$ with R_L open circuited.

R_{TH} – R_{TH} is the Thevenien's equivalent resistance which is measured between the open circuited load terminals with all the voltage or current sources replaced by their internal resistances.

The internal resistance of an ideal voltage source is zero and that of an ideal current is source is infinite.

Example network

Diagram **(1/2 Mark)**



Explanation **(1 Mark)**

Consider the example network if the figure shown below. Let us obtain the Thevenien's equivalent for this circuit.

The current through a branch (say I_2 in figure can be determined by using the Thevenien's theorem. The voltage V_{OC} (open circuited voltage) or V_{TH} (Thevenien's equivalent voltage) is obtained by removing the resistance R_2 in figure and measuring the open circuit voltage between points A and B. And R_{TH} is the Thevenien's equivalent resistance which is resistance between A and B (with R2 removed) when all the voltage/current sources are replaced by their internal resistances.

f) State the following:

i) Kirchhoff's voltage law

ii) Superposition theorem

Ans: (2 mks each)

i) Kirchhoff's voltage low

Kirchoff's law KVL:

It states that "Algebraic sum of voltages in a loop or mesh is equal to zero"
Σ voltage= 0

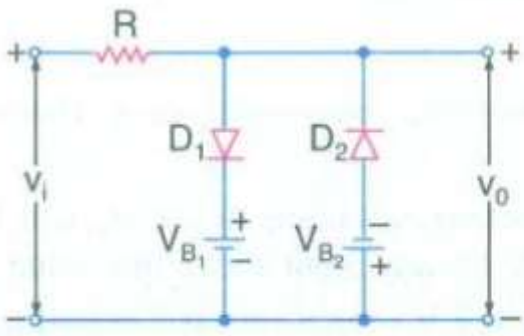
ii) Superposition theorem

The 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.

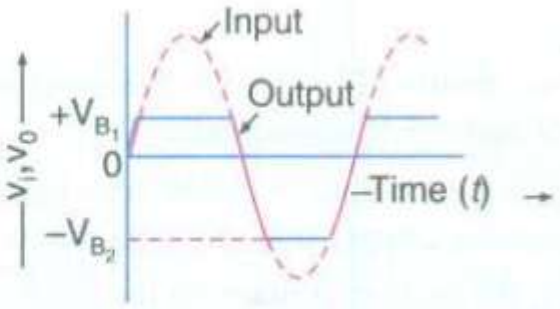
Q.6 Attempt any four of the following:

a) With the help of circuit diagram, input and output waveforms explain operation of combinational clipper.

Ans:(diagram- 2 mks, waveforms- 1 mks, operation- 1mks)



(a) Combination clipper.



(b) Input and output wave forms.

The combination of a biased positive clipper and a biased negative clipper is called combination clipper. Such a clipper circuit can clip at two-independent levels depending upon the bias voltages.

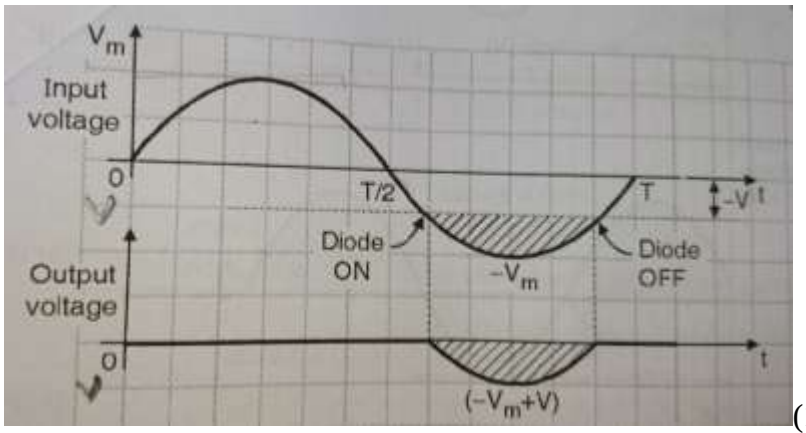
Suppose a sinusoidal a.c. voltage is applied at the input terminals of the circuit. Then during the positive half-cycle, the diode D_1 is forward biased, while diode D_2 is reverse biased. Therefore the diode D_1 will conduct and will act as short-circuit. On the other hand, diode D_2 will act as an open-circuit. However, the value of output voltage cannot exceed the voltage level of V_{B1}.

Similarly, during the negative input half-cycle, the diode D_2 acts as short circuit, while the diode D_1 as an open circuit. However, the value of output voltage cannot exceed the voltage level of V_{B1} and V_{B2}. If the values of V_{B1} and V_{B2} are equal, the circuit will clip both the positive and negative half cycles at the same voltage level. Such a circuit is known as a symmetrical clipper.

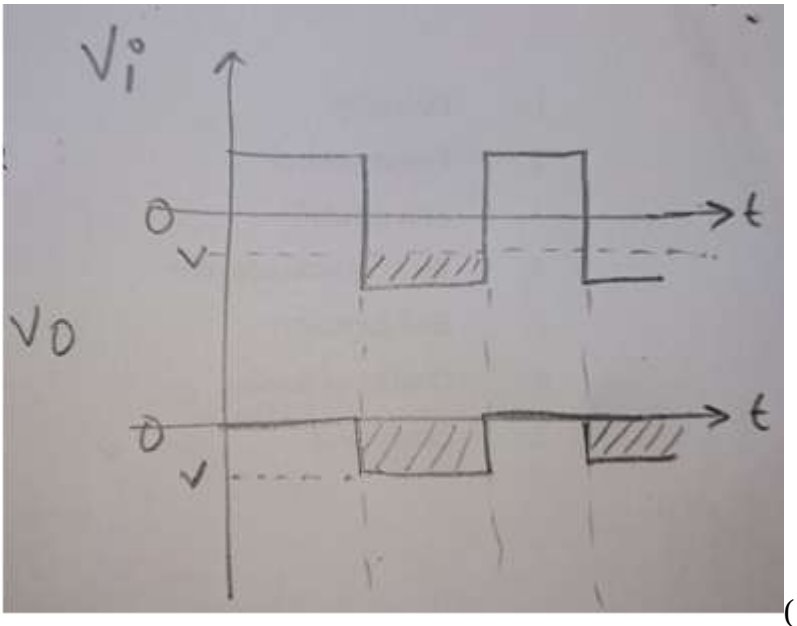
b) Identify the circuit shown in fig. no.3 .draw its input and output waveforms for sine and square wave as input.

Ans:

The above circuit is **Biased series positive clipper.** **(1 mks)**

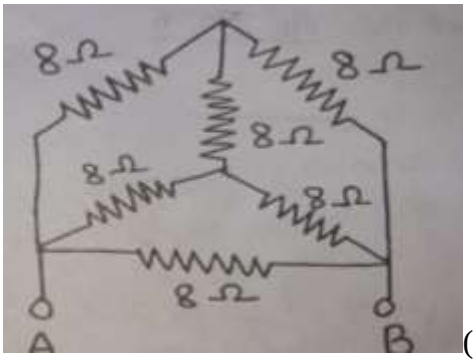


(1 ½ mks)



(1 ½ mks)

C) Calculate equivalent resistance R_{AB} between terminals A & B using delta-star transformation (refer fig.no 4)



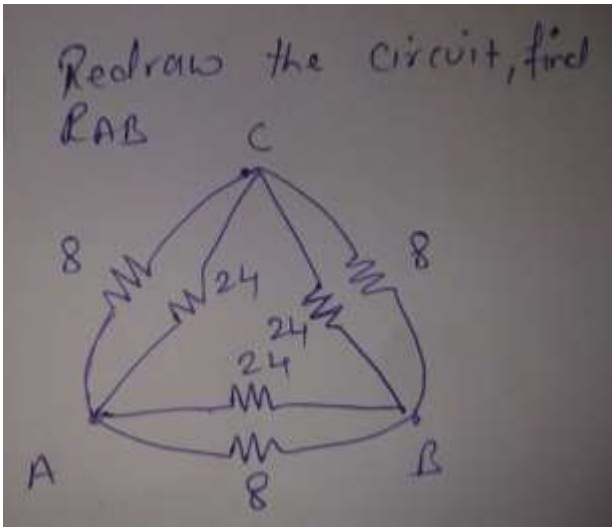
(fig 4)

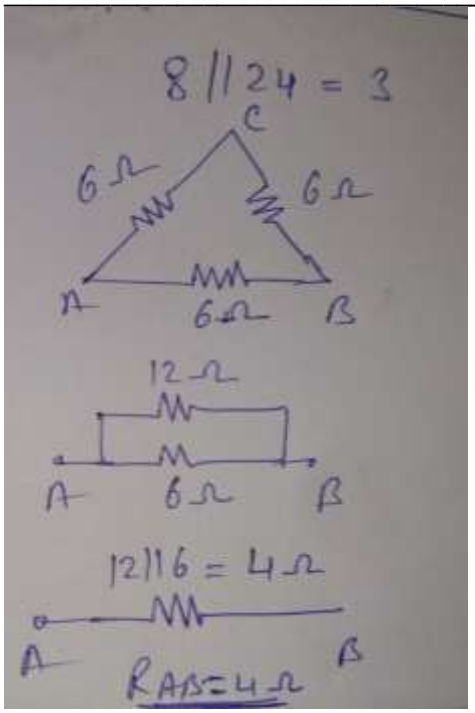
Ans:- (step by step solving with proper answer- 4 mks)

Solving for inner star to delta-

RAB=RAC=RBC= (8*8)+(8*8)+(8*8)/8=24 Ω

So the circuit becomes-





Note : Please read 8// 24 = 6 ohms

, and hence RAB = 12//6 = 4ohms

c) Find value of current in 5 ohm resistance using Norton's theorem for a network shown (refer fig.no 5)

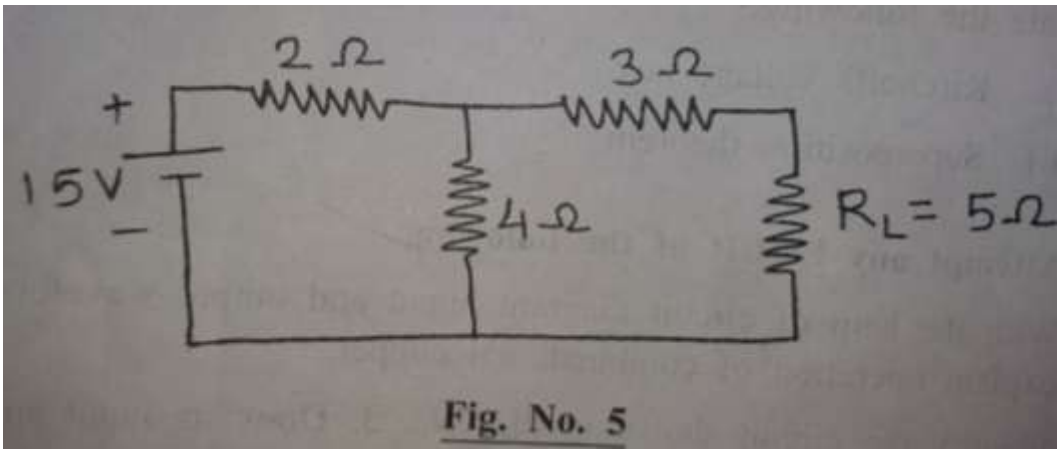
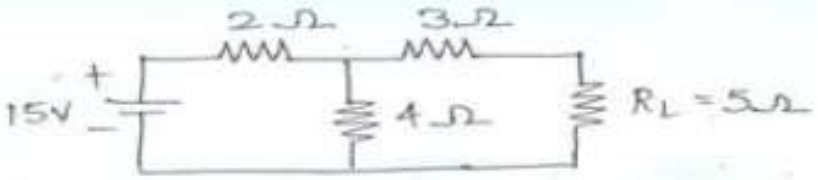


Fig. No. 5

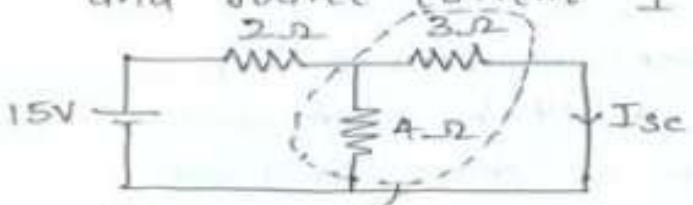
Ans:



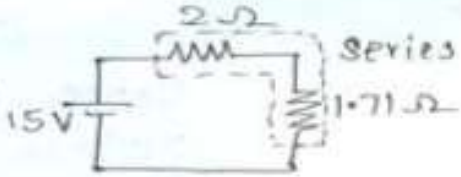
To find: Current through $R_L = 5\Omega$
Using Norton's theorem

Soln:

(1) Short the load and find total resistance R_T and source current I



$\Longrightarrow$



Parallel $3 \| 4 = \frac{3 \times 4}{3+4} = \frac{12}{7} = 1{\cdot}71\Omega$

From above figures,

$R_T = 2\Omega + 1{\cdot}71\Omega = 3{\cdot}71\Omega$

$\therefore I = \frac{15V}{R_T} = \frac{15}{3{\cdot}71} = 4{\cdot}04\,A$

1 Mark

(2) Find I_{sc}

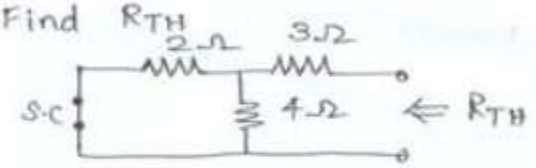
Apply current division to above figure between the parallel resistors to get,

$$I_{sc} = I \times \frac{4}{4+3} = 4.04 \times \frac{4}{7}$$

$$= 2.30\,A$$

½ Mark

(3) Find R_{TH}



$$R_{TH} = (2\Omega \,//\, 4\Omega) + 3\Omega$$

$$= \frac{2 \times 4}{2+4} + 3$$

$$= \frac{8}{6} + 3$$

$$= 1.33 + 3$$

$$R_{TH} = 4.33\,\Omega$$

½ Mark

4) Find I_L

From above figure,

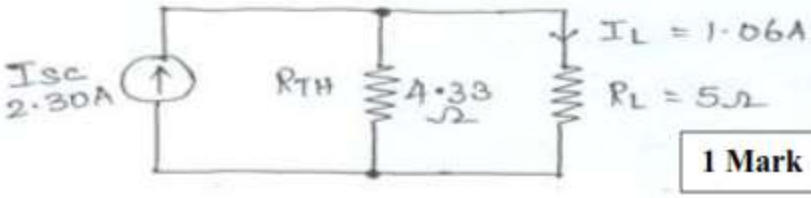
$$I_L = \frac{R_{TH}}{R_{TH} + R_L} \times I_{sc}$$

$$= \frac{4.33}{4.33+5} \times 2.30$$

$$= 1.06\,A$$

1 Mark

5) Norton's equivalent circuit



1 Mark

e) State the meaning of term open circuit and short circuit with neat diagram.

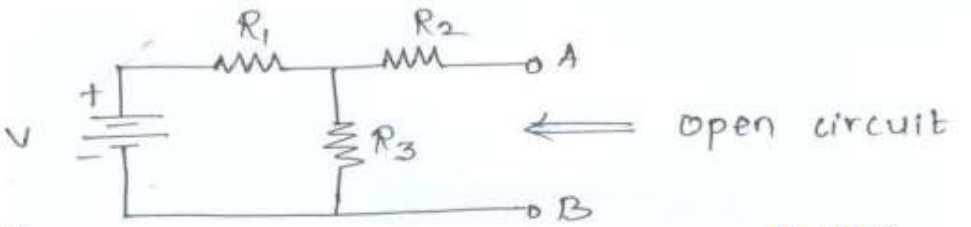
Ans:

Open Circuit **(2 Marks)**

Two points in a circuit are said to be open circuited if there is no circuit element or direct connection between them.

An open circuit exist between points 'A' and 'B' in below figure. The resistance between the open circuited points is infinite.

$$R_{AB} = \infty$$

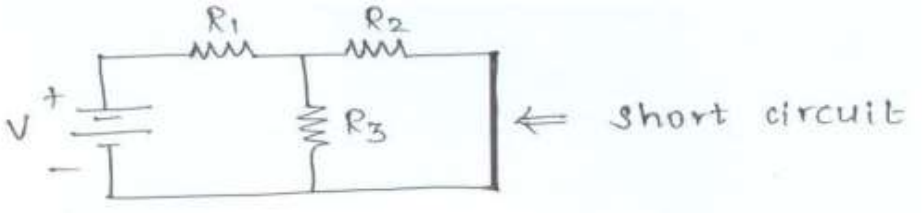


Short Circuit **(2 Marks)**

Two points in a circuit are said to be short circuited when they are connected to each other by a good conducting wire.

Points 'A' and 'B' are short circuited in below figure. The resistance between short circuited points is zero.

$$R_{AB} = 0\Omega$$



e) Calculate value of R_L so that power transferred is maximum in circuit shown in fig. no. 6. (Refer fig.no 6)

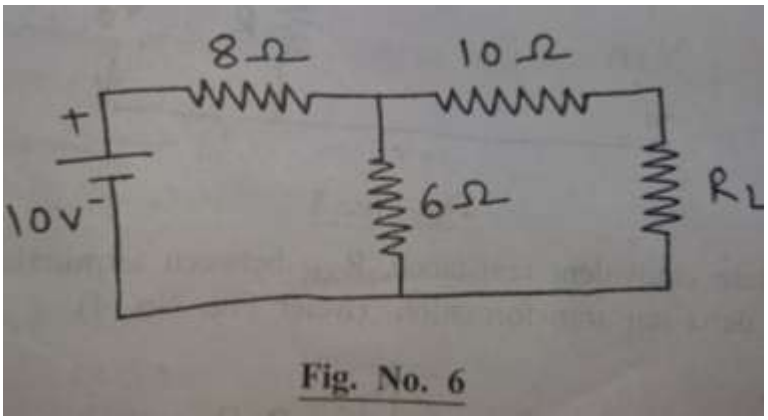


Fig. No. 6

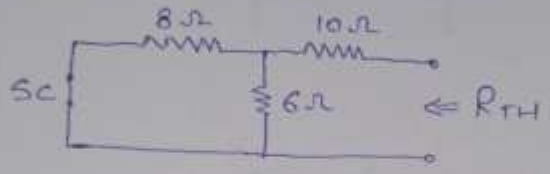
Ans:-(proper stepwise solution- 4 mks)

Soln :

1) To find equivalent resistance R_{TH}.

Hence, the R_L should be open & voltage source to be short circuited.

Hence, Circuit becomes.



$$R_{TH} = (8\Omega \,||\, 6\Omega) + 10\Omega$$

$$= \frac{8 \times 6}{8+6} + 10$$

$$= \frac{48}{14} + 10$$

$$= 3.42 + 10$$

$$= 13.42\ \Omega$$

2) For maximum power transfer to take place,

$$R_L = R_{TH}$$

$$\therefore R_L = 13.42\ \Omega$$

3) Final circuit