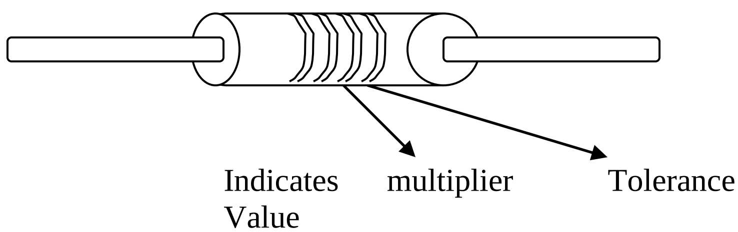
PART –B

Experiment 1:

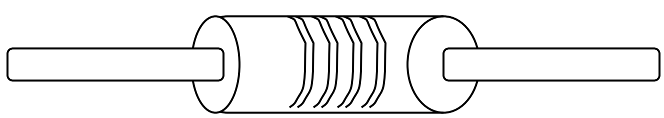
Identification, Specifications and Testing of R, L, C Components (color codes), Bread Boards

RESISTOR:
Resistor is an electronic component whose function is to limit the flow of current in an electric circuit.It is measured in units called ohms. The symbol for ohm is Ω (omega).
They are available in different values, shapes and sizes. Every material has some resistance. Some materials such as Rubber, Glass and air have very high opposition to current to flow .These materials are called insulators. Other materials such as Copper, Silver and Aluminum etc. Has very low resistance, they are called Conductors.

IDENTIFICATION:-
1) Color Coded Resistor



2) Printed Resistor



Color codes
The most common type has color bands to indicate its resistance. The code is a standard one adopted by manufactures through their trade association, the electronic Industries Association (EIA).

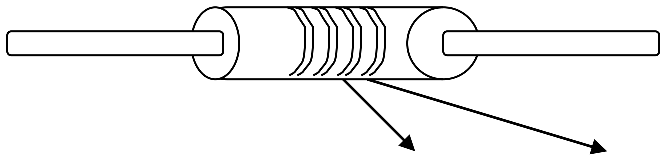
Color code and its value, multipliers

Bl --	Black → 0	10^0
Br --	Brown → 1	10^1
R --	Red → 2	10^2
O --	Orange → 3	10^3
Y --	Yellow → 4	10^4
G --	Green → 5	10^5
B --	Blue → 6	10^6
V --	Violet → 7	10^7
G --	Gray → 8	10^8
W --	White → 9	10^9

Multipliers, Tolerance

Br --	Brown →	± 1%
R --	Red →	± 2%
G --	Gold →	0.1, ± 5%
S --	Silver →	0.01, ± 10%
No color	→	± 20%
Pink	→	High stability

Resistor



First color band tells the first significant figure of the resistors value.
Second color band indicates the second significant figure in the resistors value.
Third color band indicates the no. of zeros to add to the first two significant numbers often called as multiplier.
Fourth color band indicates the tolerance.

Estimation of resistance value using color code for eg:a resistor has a color band of Brown, Green, and Orange with a tolerance band Gold

Then

Br → 1
G → 5
O → 3

First two colors is the value 15
Third color is multiplier, therefore x 10^3
i.e., 15 x 10^3 = 15000 → 15 kΩ
Fourth band Gold implies Tolerance of ± 5%
Therefore 15 kΩ ± (5% of 15k)

Note:
By tolerance we mean that acceptable deviation or the actual value of the resistor may be 5% more or less then the coded value.

If the resistor contains 5 color bands ,then the first three color bands indicates the first ,second and third significant figure in the resistors value , the fourth color band is the multiplier and the fifth color band indicates tolerance.

SPECIFICATIONS:

Carbon composition resistors are available from few ohms to several mega ohms.
Typical resistor wattage sizes are 1/8, 1/4, 1/2, 1, 2, 5, 10 and 20 (w) units, depending on thickness of leads Wattage of resistors can be decided.
In writing the values of resistors, the following designation are used Ω, KΩ, MΩ
K → kilo → 10^3
M → Mega → 10^6
Commonly available wire wound Resistors have resistance values ranging from 1Ω to 100KΩ with power rating upto about 200W.

All resistance materials have a change in resistance with temperature.

$R_{T1} = R_{T2} [1 + \alpha (T1 - T2)]$
Where RT1 is resistance at T_1 ^{0}C
α is the temperature coefficient
R_{T2} is resistance at T_2 ^{0}C.

Temperature coefficient is important to designer so as to perform satisfactorily when the circuit is exposed to temperature variations.

Voltage coefficient: Resistances other than wire wound have a slight change with the applied voltage, generally it decreases with increase in voltage.

$$\text{Voltage coefficient (In PPM)} = \frac{R1 - R2}{R2} * \frac{1}{(V1 - V2)} * 10^6$$

(Parts Per Million)

Testing:
Determine the resistance value of various resistors using color code and DMM .
Measure the resistance of each resistor and complete the below table.

S.NO	Color Coded Resistance Value	Color Coded Tolerance	Measured Value(using DMM)

Note:
1) The measured Resistance and the color coded resistance should agree with in the the tolerance range of the resistor.
2) Do not touch both resistor leads while making the measurement, if you do so, DMM will measure your body resistance as well as the resistor.

APPLICATIONS:
It is widely used in electronic circuits to limit the current.

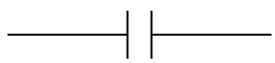
CAPACITORS:

It is a device which stores a charge. It does not pass direct current (dc) but will effectively allow the flow of alternating current (ac). The reactance of a capacitor 'C' is dependent on the freq of the ac signal and is given by

$$X_C = \frac{1}{2\pi fc}$$

A capacitor 'c' when charged to a voltage has a stored energy of $\frac{1}{2}$ CV^2 Joules. A capacitor essentially consists of two conducting plates separated by a dielectric medium.

Symbol:



Capacitance of a capacitor 'c' is given by

$$C = \frac{\in A}{d} F$$

The SI unit of capacitance is Farad (F)

The Farad is the capacitance of a capacitor that contains a charge of 1 Couloumb when the potential difference between its terminals is 1Volt and it stores energy, capacitor does not pass Direct current but allows the flow of alternating current.

IDENTIFICATION:

Capacitors dielectric is largely responsible for determining its most important characteristics. Hence capacitor is usually identified by the type of dielectric used.

Ex: Air capacitors, mica capacitor, ceramic capacitor, plastic film capacitor, electrolytic capacitor, and tantalum capacitors.
There are two types of capacitors
1) electrolytic
2) non-electrolytic
The electrolytic capacitors use insulation (dielectric) which is chemically active. The capacitor is marked with a +ve & -ve lead polarity.
Note: Be sure to connect any capacitor with marked plus & minus(-) leads to correct polarity.
Non electrolytic capacitors can be connected to the circuit with any polarity.
Note: 1) Charging of capacitor
When a capacitor is connected to a power source it is charged, and maintains the charge even after the power source is disconnected.
2) Discharging of capacitor
When capacitor leads are connected to a resistor or short circuited the stored charge results in current flow and when stored charge is removed the capacitor is said to be discharged.

Color code:

COLOR	SIGNIFICANT FIGURE	TOLERANCE (%)
Black	0	20
Brown	1	1
Red	2	2
Orange	3	3
Yellow	4	4
Green	5	5
Blue	6	6
Voilet	7	7
Grey	8	8
White	9	9
Silver	0.01	10
Gold	0.1	5
No band	----	20

1. It is measured in units called Farad (F).

2. Symbol = +——||——–

3. Values of capacitors can be designated as μF, pF, nF
   μF = micro farads = 10^{-6}F
   pF = pico farads = 10^{-12}F
   nF = nano farads = 10^{-9}F

4. The dielectric constant of the capacitor is a function of temperature, frequency & voltage of operation. The value decreases with frequency while the changes with temperature may be either +ve or –ve. The temperature co-efficient values for the various capacitor dielectrics are approximately given below
   Mica = 100 ppm/^{o} C
   Ceramic – low ε + 80 – 120 ppm/C
   Medium ε - 500 to -800 ppm/^{o}C

5. The power factor of a capacitor is theoretically zero, since p.f = R/Z & R is zero for a pure capacitor.

The various dielectric material & the ranges of values these dielectrics can provide are shown

Dielectric	**E**	**Capacitance in μF per cubic cm.**			**Available range μF**
		For 100V	500V	1000 V	
1.Natural Mica	6	0.004	0.001	0.0007	10 pF – 0.1μF
2.Ceramic	100-5000	0.2	0.02	0.007	10pF – 0.01μF
3.Electrolytic	7	08.	0.2	0.06	1 to 1000 μF

Testing for capacitance:

1. Determine the value and type of each capacitor from its colour code.
2. Measure the value of capacitance using DMM. And complete the below table.

S.NO	Capacitor type	ColorCoded Tolerance	Measured capacitance (using DMM)

APPLICATIONS:
1. In tuned circuits.
2. As bypass capacitors to by pass ac through it.
3. Blocking capacitor to block dc components.

Ganged Condensers:

In tuning circuits it is desired to change the value of capacitance readily, this is done by means of variable capacitors. The most common variable capacitor is the air ganged capacitor. By rotating the shaft, we can change the distance between movable and fixed sets of plates like that capacitance value is changed.

Applications:

Used in tuning circuits

Inductors:

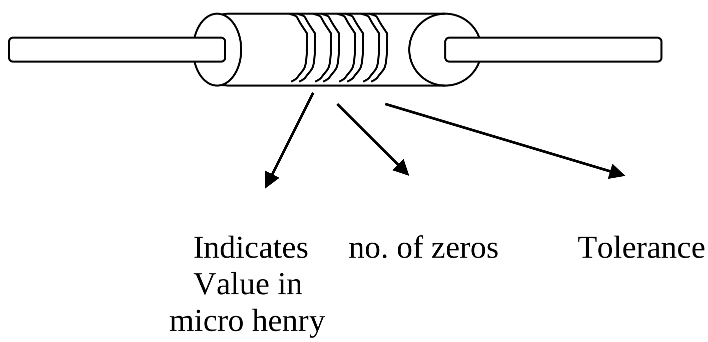
When current flow through a wire that has been coiled, it generates a MF which opposes any change in the current this keeps the current flow at a steady rate, its reaction of MF is known as inductance.

The electronic component producing inductance is called inductor.inductance is measured in henry.

Identification:

Types of inductors are

1. air core
2. ferromagnetic core
3. molded inductors
4. thin film inductors



Color code:

COLOR	SIGNIFICANT FIGURE	TOLERANCE (%)
Black	0	
Brown	1	
Red	2	
Orange	3	
Yellow	4	
Green	5	
Blue	6	
Violet	7	
Grey	8	
White	9	
Silver		10
Gold	decimal point	5
No band		20

Specifications:
Typical values range from milli Henry to micro Henry.

Testing for inductor:

Measure the value of inductor using LCR tester and complete the below table.

S.NO	inductor type	Color Coded value	Measured inductor (using LCR)

Applications:

1. Filter chokes for smoothing and pulsating currents produced by rectifiers.
2. Audio frequency chokes, to provide high impedance at audio frequencies.

Switches:

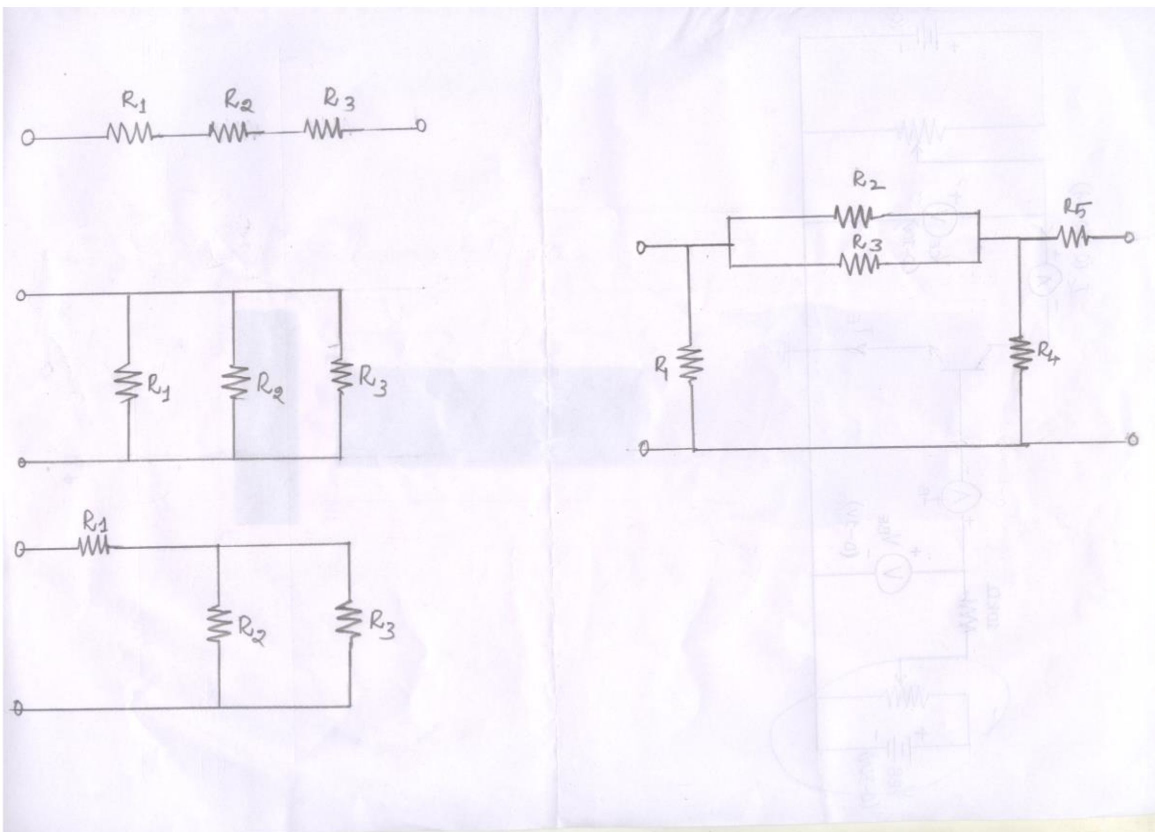
A switch is a device which can connect two points in a circuit (or) disconnect two points. If the switch is acting so has to connect two points. It is said to be in ON position. If the switch is acting so has to disconnect two points. It is said to be in OFF position.

Bread Boards:

This is the platform (or chasis) on which any circuit can be ringed up to provide inter connections between electronics components and devices.

The advantage of bread board is, the components can be connected (or) disconnected easily. It has holes both horizontally and vertically as shown in the figure.

The horizontal holes at the top and bottom are having internal shorts where as in the remaining part vertical holes are shorted internally



2. CHARACTERISTICS OF P-N JUNCTION DIODE

I.AIM

1. Study of semiconductor diode characteristics under forward and reverse bias condition
2. To find the static and dynamic resistance

II. i. EQUIPMENT

1. Regulated dual power supply (0 – 30 V) – 1 No.
2. Moving coil ammeter (0 – 30) mA – 1 No.
3. Moving coil voltmeter (0-1) V, (0-300) V - 1 No. each
4. Bread board – 1 no.
5. Single strand connecting wires

ii. COMPONENTS

1. 1N4148 - 1 No.
2. OA79 - 1 No.
3. 1 kΩ Resistor - 1 No. (1/2 W, carbon)

III THEORY

A p-type semiconductor in contact with an n-type semiconductor constitutes a p-n junction. p-n junction is a p-n diode which permits the easy flow of current in one direction but restrains the flow in opposite direction.

In forward bias condition, the positive terminal of the battery is connected to the p-side of the diode and negative terminal to the n side. In forward bias, when the applied voltage is increased from zero, hardly any current flows through the diode in the beginning. It is so because the external voltage is being opposed by the barrier voltage V_B whose value is 0.7 volts for silicon and 0.3 volts for germanium. As soon as V_B is neutralized, current through the diode increases rapidly with increase of applied voltage. Here, the current is in the order of mA

When the diode is in reverse bias, the majority carriers are blocked, and only a small current due to minority carriers flows through the diode. As the reverse voltage is increased from zero, the reverse current increases and reaches a maximum saturation value I_o, which is also known as reverse saturation current. This is in the order of nA for silicon and μA for germanium.

The current I flowing through the diode is related to the applied voltage by the following equation whether the diode is in forward bias or in reverse bias.

$$I = I_O\left(e^{V/\eta V_T} - 1\right)$$

I_O= Reverse saturation current
V = applied voltage
I = current for the applied voltage V
η = 1 for Ge and 2 for Si
V_T = T/ 11600 volts

IV CIRCUIT DIAGRAM

i. Forward bias

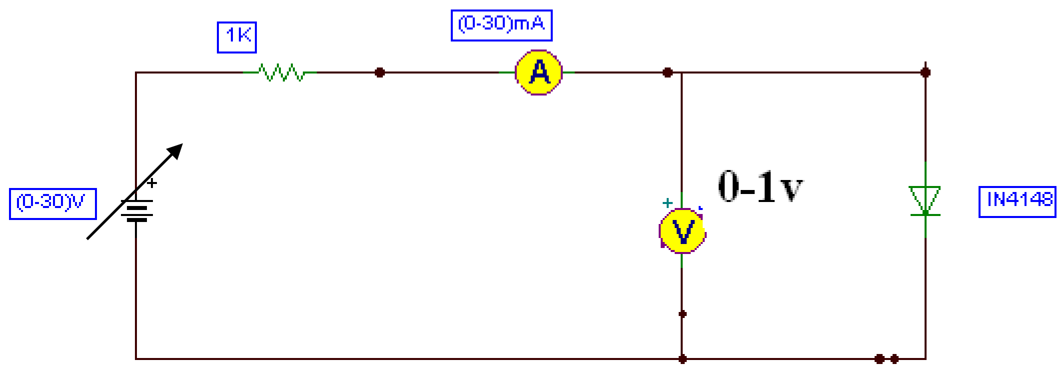


Figure.1

ii. Reverse bias

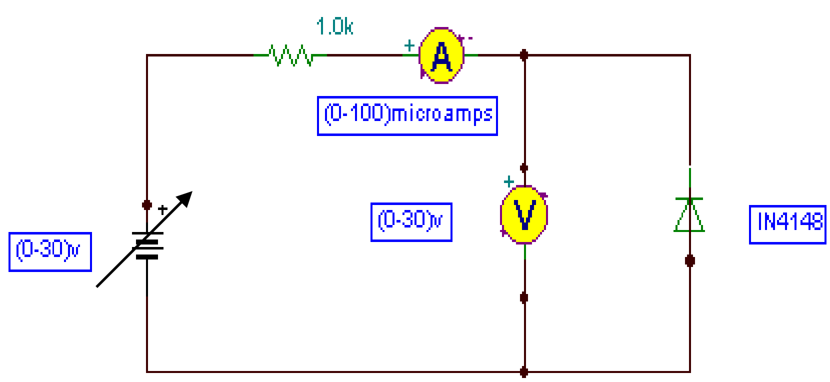


Figure. 2

V PROCEDURE

i. Forward Bias condition

1. Connect the circuit as per the given circuit diagram shown in figure:1
2. Vary the power supply voltage in such a way that the voltmeter reading is 0.1V. Note the corresponding current reading in Ammeter.
3. Repeat step-2 by increasing the voltage in steps of 0.1V, till 1.0V.
4. Plot a graph taking voltage (V) on X axis and current (I) on Y axis
5. Draw a vertical line at 0.7 V, note down the corresponding current value.

Static Resistance $r_{dc} = \frac{0.7}{I}$

6. Draw the vertical line at 0.75V, note down the corresponding current value.

   Dynamic Resistance $\gamma_{ac} = \frac{\Delta V}{\Delta I}$ = (0.75 – 0.7)/ (I_2 – I_1)

   Where, I_1 and I_2 are the corresponding values of current at 0.7 and 0.75 V.

ii. Reverse bias condition

1. Connect the circuit as per the circuit diagram shown in figure:2
2. Vary the power supply voltage in such a way that the volt meter reading is 1V. Note the corresponding current reading in Ammeter.
3. Repeat step-2 by increasing the voltage in steps of 1V, till 20V.
4. Plot a graph taking the voltage (V) on X-axis and current (I) on Y-axis.
5. Draw the horizontal line at -4V, note down the corresponding current values.
6. Reverse dc Resistance $R_R = \frac{\text{Reverse voltage}}{\text{Reverse current}}$ = 4/I

VI. <u>OBSERVATIONS</u>

i. Forward Bias

V_D (volts)	I_D (mA)
0 0.1 0.2 1	

ii. Reverse Bias

V_D (volts)	I_D (µA)
0 1 2 20	

VII. CALCULATIONS

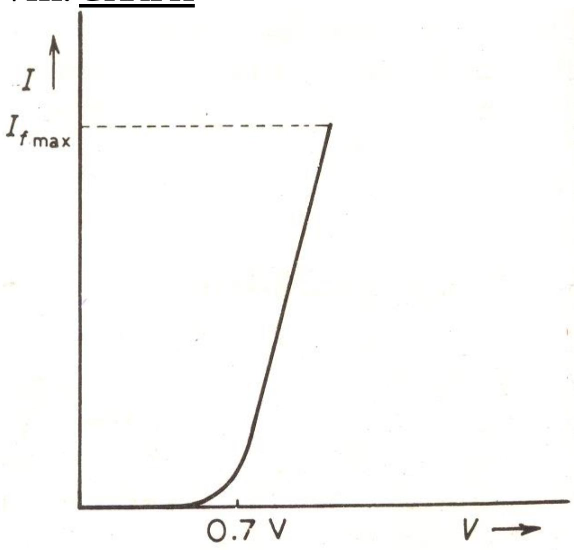
Forward Bias

Dynamic Resistance = $\frac{\Delta V_D}{\Delta I_D}$

Static Resistance = $\frac{V_D}{I_D} = \frac{0.7}{I_D}$

Reverse Resistance = R_R = $\frac{\text{Reverse voltage}}{\text{Reverse current}}$

VIII. GRAPH



Forward characteristics of a silicon diode

IX RESULT

Dynamic Resistance =
IN4148
Static Resistance =
IN4148
Reverse Resistance =
IN4148

X. INFERENCE

The current in the forward bias is observed in the order of mA. The current in the reverse bias is observed in the order of μA for Ge and mA for Si diode. Usually, the forward resistance range is 0 Ω to 100 Ω and in the reverse bias, it is in the order of MΩ. Therefore the characteristics of pn junction diode are verified.

XI. PRECAUTIONS

1. Maximum forward current should not exceed the value which is given in the datasheet. If the forward current in a pn junction is more than this rating, the junction will be destroyed due to overheating

2. Reverse voltage across the diode should not exceed peak inverse voltage (PIV). PIV is the max. reverse voltage that can be applied to a pn junction without any damage to the junction.

XII. APPLICATIONS

1. It is used in several Electronic circuits like rectifiers etc.
2. It is used in communication circuits for modulation and demodulation of high frequency signals.
3. It is used in logic circuits that are fundamental building blocks of computers.
4. It is used in wave shaping circuits like clippers and clampers.

XIV. TROUBLE SHOOTING

S.No.	**Fault**	**Diagnosis**
1	No reading in the Ammeter	Check the diode for any open circuit
2	No reading in Voltmeter	Check the diode for any short circuit
3	No increase in the power supply voltage	Check the current limit in RPS. Increase the current limit, if required

XV. QUESTIONS

1. What is cut-in voltage for germanium diode?
2. What is cut-in voltage for silicon diode?
3. What is meant by PIV?

4. What is reverse saturation current?
5. What are the reasons for the development of potential barrier across a pin junction?
6. What is meant depletion region?
7. Mention the materials used for doping an intrinsic semi conductor material?
8. What is meant by majority carriers and minority carriers?
9. Describe the effect of increasing the reverse bias voltage to high values?
10. What are essential differences between Ge and Si diode?

3. ZENER DIODE

1. AIM:

1. To plot the V-I characteristics of ZENER diode under forward and reverse bias conditions.
2. To find ZENER voltage, forward bias resistance & reverse bias resistance after ZENER Breakdown.

2. i. EQUIPMENTS REQUIRED:

1. Bread Board
2. Connecting wires
3. Volt meter (0 - 20V)
4. Ammeter (0 - 20 mA), (0 – 20mA)
5. Regulator DC power supply.

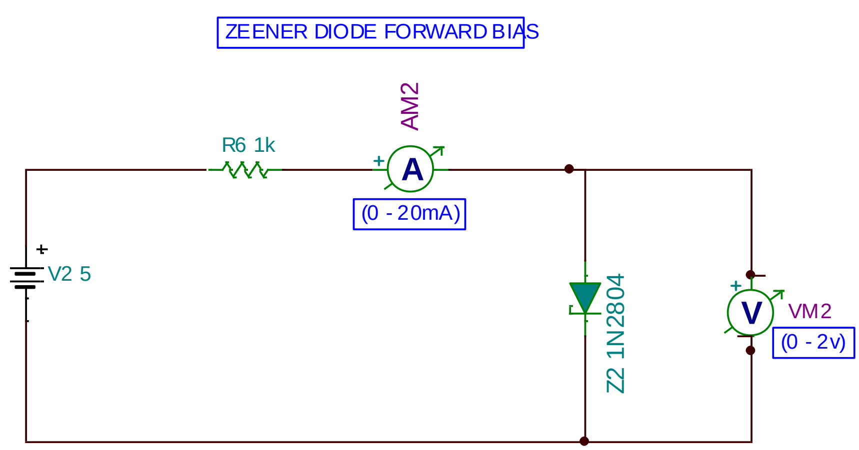
ii. COMPONENTS REQUIRED:

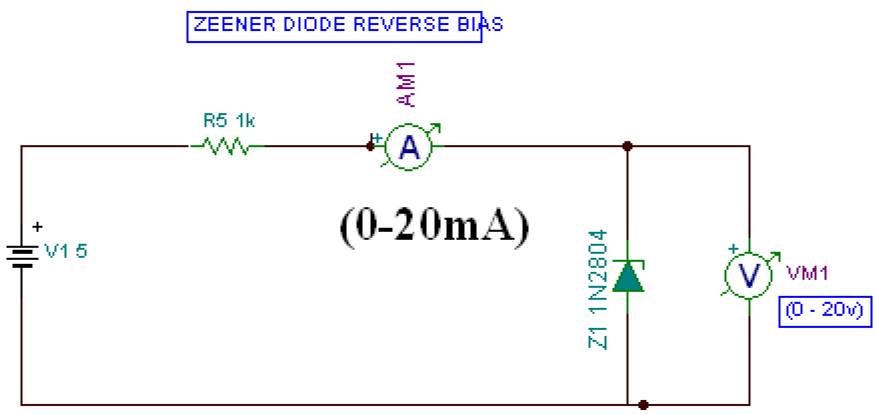
1. Zener diode (IN 2804)
2. Resistor (1kΩ)

3. THEORY:

Zener diode acts as normal PN junction diode. And during reverse bias as reverse voltage reaches breakdown voltage diode starts conducting. To avoid high current, we connect series resistor with it. Once the diode starts conducting it maintains constant voltage across it. Specially made to work in the break down region. It is used as voltage regulator.

4. CIRCUIT





5. PROCEDURE:

Forward Bias:

1. Connect the circuit as per the circuit diagram.
2. The DC power supply is increased gradually in steps of 1 volt.
3. Corresponding Voltmeter and Ammeter readings are noted and the V-I characteristics are plotted with zener voltage on X axis and current along the Y axis.
4. Break voltage is found and the break down resistance of zener diode is calculated.

Reverse Bias:

1. Connect the circuit as per the circuit diagram.
2. The DC power supply is increased gradually in steps of 1 volt.
3. Corresponding Voltmeter and Ammeter readings are noted and the V-I characteristics are plotted with zener voltage on X axis and current along the Y axis.
4. Break voltage is found and the break down resistance of zener diode is calculated

6. OBSERVATION TABLE

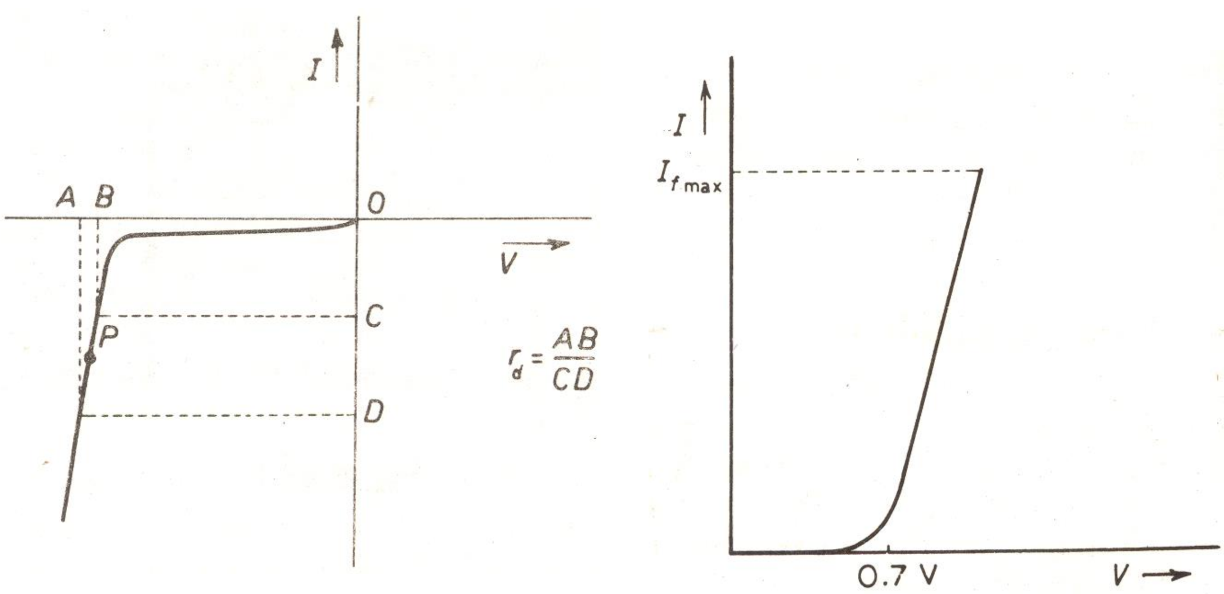
Forward bias

Sl No	Voltmeter reading In volt	Ammter reading In mA

Reverse bias

Sl. No	Voltmeter reading In volt	Ammeter reading In mA

GRAPH



7. INTERFERENCE:
Zener diode is having a very sharp break down. That is for constant voltage different currents can flow through it Zener diode can be operated in reverse bias.

8. PRECAUTION
1. It is preferable to use digital Multimeter in place of analog voltmeter
2. Maximum current should not exceed the value which is given on the data sheet.

9. TROUBLE SHOOTING

If no deflection on ammeter and voltmeter, check the should not be loose contacts in the circuit.

10. RESULT:

Zener Voltage = _______________
Forward bias resistance =__________
Reverse bias resistance = __________

11. EXTENSION

Zener diode can be used as a voltage regulator.

12. APPLICATION

1. Zener diode is used as voltage regulator.
2. Used in some clipper circuit.
3. Used as reference voltage in some circuits.

13. QUESTIONS

1. What is Zener diode
2. What is breakdown voltage of Zener diode
3. What is avalanche breakdown
4. What is doping concentration of Zener diode
5. How is Zener diode different from PN junction diode

4. CHARACTERISTICS OF BJT IN CE CONFIGURATION

1) AIM:
1) To study and plot the input and output characteristics of BJT in CE configuration.
2) Find the current amplification factorβ.
3) Find the dynamic input & output Resistance.

2) i. APPARATUS:
Dual Regulated power supply (0 – 30) V
Moving coil ammeter (0 – 10 mA), (0 -1mA)
Moving coil voltmeter (0 – 1 V), (0 – 10 V)
Bread board - 1
Connecting wires (single strand)

ii.) COMPONENTS: –
Transistor BC107
Resistor – (10 kΩ)

3) THEORY:
In this CE arrangement, input is applied between base & emitter terminals and output is taken from collector and emitter terminals. Here emitter of the transistor is common to both input and output circuits. Hence the name Common Emitter (CE) configuration.

For CE configuration, we define the important parameters as follows:

1. The base current amplification factor (β) is the ratio of change in collector current ΔI_C to the change in base current ΔI_B is known as Base current amplification factor.

$$\beta = \frac{\Delta I_C}{\Delta I_B} |_{V_{CB} = const}$$

In almost any transistor, less than 5% of emitter current flows as the base current. The value of β is generally greater than 20.Usually its value ranges from 20 to 500. This type of arrangement or configuration is frequently used as it gives appreciable current gain as well as voltage gain.

2. Input resistance is the ratio of change in base-emitter voltage to the change in base-current at constant V_{CE}

i.e.,

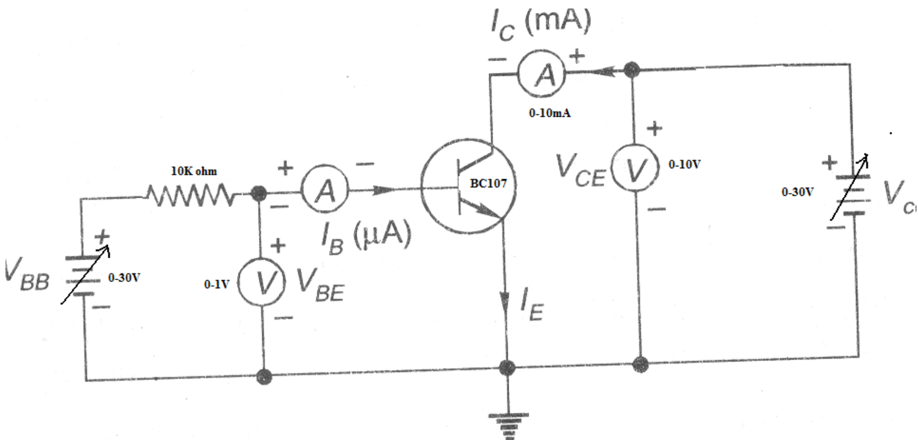
$$r_i = \frac{\Delta V_{BE}}{\Delta I_B} |_{.V_{CE} = const}$$

The value of input resistance for the CE circuit is of the order of a few hundredΩ’s.

3. Output resistance is the ratio of change in collector-emitter voltage to change in collector current at constant I_B.

$$r_O = \frac{\Delta V_{Ce}}{\Delta I_C} |_{I_E = const}$$ .It is in the order of 50 kΩ

4. CIRCUIT DIAGRAM:



5. PROCEDURE

Input characteristics

1. Connect the circuit as per the given circuit diagram on bread board
2. Set V_{CE} = 5V, vary V_{BE} in steps of 0.1V & note down the corresponding I_B. Repeat the above procedure for 10V, 15V & 20V
3. Plot the graph V_{BE} Vs I_B for a constant V_{CE} taking V_{BE} is taken on x axis & I_B on y axis
4. Calculate input resistance $\frac{\Delta V_{BE}}{\Delta I_B} |_{V_{CE} = const}$

Output Characteristics

1. Connect the circuit as per the given circuit diagram on the bread board
2. Open the input circuit, vary the collector voltage V_{CE} in steps of 1V and note down the corresponding collector current Ic.
3. Set I_B= 20µA, vary V_{CE} in steps of 1V and note down the corresponding I_C. Repeat the above procedure for 40µA, 80µA, 100µA.
4. Plot the graph taking V_{CE} on X-axis & I_C on y-axis at corresponding constant I_B
5. Calculate the output resistance $\frac{\Delta V_{CE}}{\Delta I_C} |_{I_B = const}$
6. Calculate the current amplification factor $\beta = \frac{\Delta I_C}{\Delta I_B} |_{V_{CB} = const}$

6. TABULAR FORM

I/p Characteristics

V_{CE} = 5V	
V_{BE}(V)	I_B(mA)

V_{CE} = 10V	
V_{BE}(V)	I_B(mA)

V_{CE} = 15V	
V_{BE}(V)	I_B(mA)

O/p Characteristics

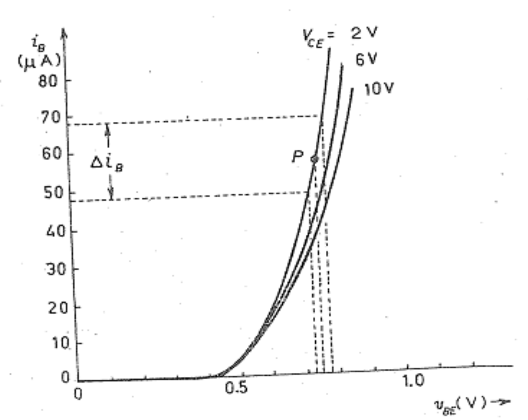
I_B = 20μA	
V_{CE}	I_C(mA)

I_B = 40μA	
V_{CE}	I_C(mA)

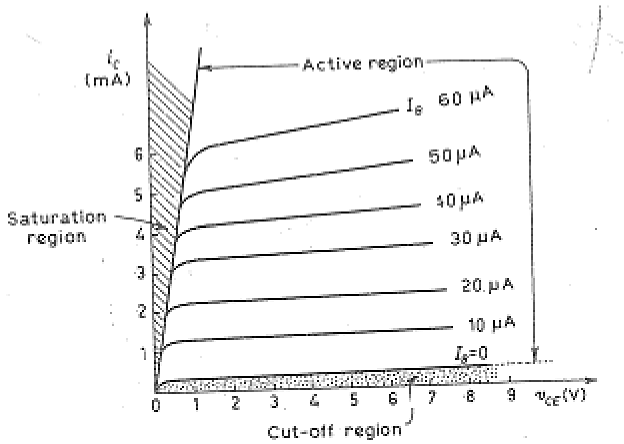
I_B = 60μA	
V_{CE}	I_C(mA)

7. **GRAPH**: -

Input Characteristics: -



Output Characteristics: -



8) CALCULATIONS: -

I/p Resistance = $\frac{\Delta V_{BE}}{\Delta I_B} |_{V_{CE} = const}$

O/p Resistance = $\frac{\Delta V_{CE}}{\Delta I_C} |_{I_B = const}$

Current amplification factor $\beta = \frac{\Delta I_C}{\Delta I_B} |_{V_{CB} = const}$

9) RESULTS: -

1. Input and output characteristics are plotted on the graph.
2. The transistor parameters are given below

Dynamic I/p Resistance = _______
Dynamic O/p Resistance = _______
Current amplification factor β=_____

10) INFERENCE: -

I/p characteristics: -

1. As compared to CB arrangement I_B increases less rapidly with V_{BE}. Input resistance of CE circuit is higher than that of CB circuit.
2. Input characteristics resemble that of a forward biased pn junction diode curve. This is expected since the base emitter section of a transistor is a pn junction.

O/p characteristics

1. For any value of V_{CE} above knee voltage, the collector current I_C is approximately equal to βI_B.
2. The collector current is not zero when I_B is zero. It has a value of I_{CEO}, the reverse leakage current.

11. APPLICATIONS:

1) Used as amplifier
2) Used in communication circuits
3) Used as a switch
4) Used in audio frequency applications

12. QUESTIONS:

1) What is Transistor?
2) Draw the npn & pnp transistor symbols.
3) Why base region is made thin?
4) Why is transistor not equivalent to two pn junction diodes connected back to back?
5) Why is collector current slightly less than emitter current?
6) What is the significance of arrow in the transistor symbol?
7) What isβ?
8) What is the range of input resistance?
9) What is the range of output resistance?
10) Why small change in α leads to large change in β.

5. HALF WAVE RECTIFIER WITH AND WITHOUT FILTER

1. AIM:
1. To examine the input and output waveform of half wave rectifier
2. To find ripple factor and percentage regulation.

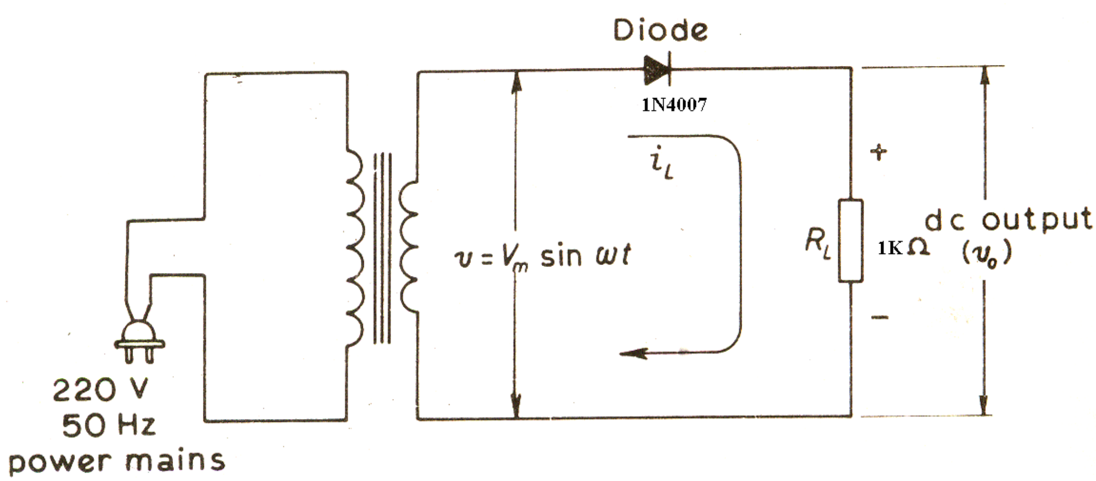
2. i. EQUIPMENTS REQUIRED:
1. Bread Board
2. CRO
3. Connecting wires
4. Digital multimeter
5. TransformerPrimary voltage (0-230v)
6. BNC probes

ii. COMPONENTS REQUIRED:
1. Capacitor (100µF)
2. Diode (1N4007)
3. Resistor (1kΩ)

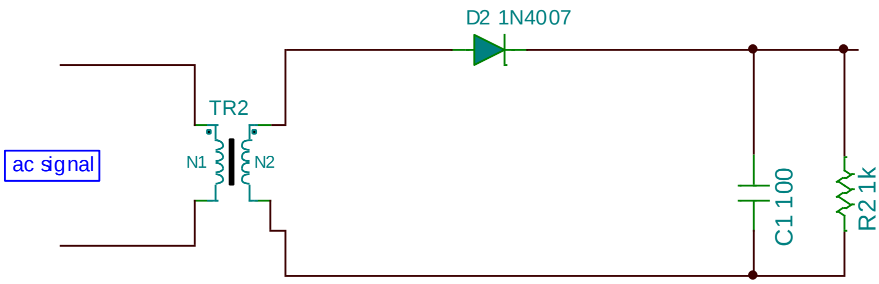
3. THEORY:

In Halfwave rectifier there is one diode, transformer and a load resistance. During the positive half cycle of the input, diode is ON and it conducts current and flows through load resistance ,voltage is developed across it. During the negative half cycle the diode is reversed biased, no current conduction so no current through load resistance and no voltage across load resistance

4. CIRCUIT DIAGRAM



Half-wave rectifier circuit



5. PROCEDURE:

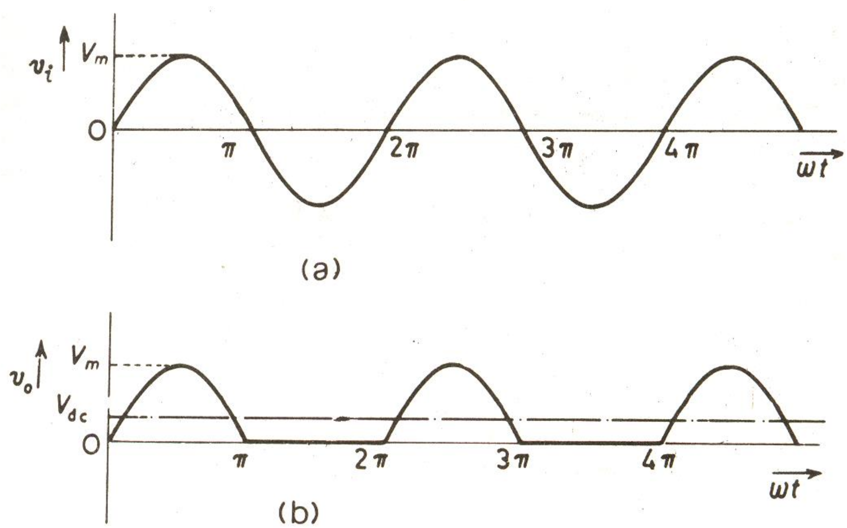
Without filter:

1. Connect the circuit as per the circuit diagram
2. Observe the voltage wave form across the secondary of the transformer and also across the output in CRO.
3. Measure ac voltage, dc voltage, no load and full load voltages with DMM.

With filter:

1. Connect the circuit as per the circuit diagram
2. Do not connect the capacitor, first get the circuit is verified.
3. Observe the voltage wave form across the secondary of the transformer and also across the output in CRO Connecting the capacitor.
4. Measure ac voltage, dc voltage, no load and full load voltages with DMM.

Graph:



Half-wave rectifier: (*a*) Input voltage waveform (*b*) Output voltage waveform

6. OBSERVATIONS

Without filter:

Ac voltage= no load voltage=

Dc votage= full load voltage=

With filter:

Ac voltage= no load voltage=

Dc votage= full load voltage=

7. INFERENCE

As diode can be used as a switch so it is used in rectifier circuit to convert AC signal to DC signal, but not perfect DC IT IS PULSETING dc.

8. PRECAUTIONS

1. Waveforms should be observed on CRO keeping in DC mode.
2. Use digital meter instead of analog meter.

9. TROUBLE SHOOTINGS

No meter reading then check if there are any loose connection.

10. RESULT:

Ripple factor = ac voltage/dc voltage = ____________________

$$\text{Percentage regulation } = \frac{V_{noload} - V_{fullload}}{V_{fullload}} x100\% = $$ __________________

11. EXTENSSION

Efficiency of the circuit is less so we go for full wave rectifier.

12. APPLICATIONS

1. Used to convert AC signal to pulsating DC.
2. Clippers.

13. QUESTION

1. Explain the operation of half wave rectifier.
2. Derive rms & avg value of output of half wave rectifier.
3. Derive ripple factor of half wave rectifier.
4. Derive efficiency of half wave rectifier
5. What is peak factor, form factor of half wave rectifier
6. What is TUF of half wave rectifier
7. What should be PIV of diode in half wave rectifier

6. FULL WAVE RECTIFIER WITH AND WITHOUT FILTER

1. AIM:

1. To examine the input and output waveform of full wave rectifier
2. To find ripple factor and percentage regulation.

2. EQUIPMENTS REQUIRED:

i. Apparatus:

1. Bread Board
2. CRO
3. Connecting wires
4. Digital Multimeter
5. TransformerPrimary voltage (0-230v)
6. BNC probes

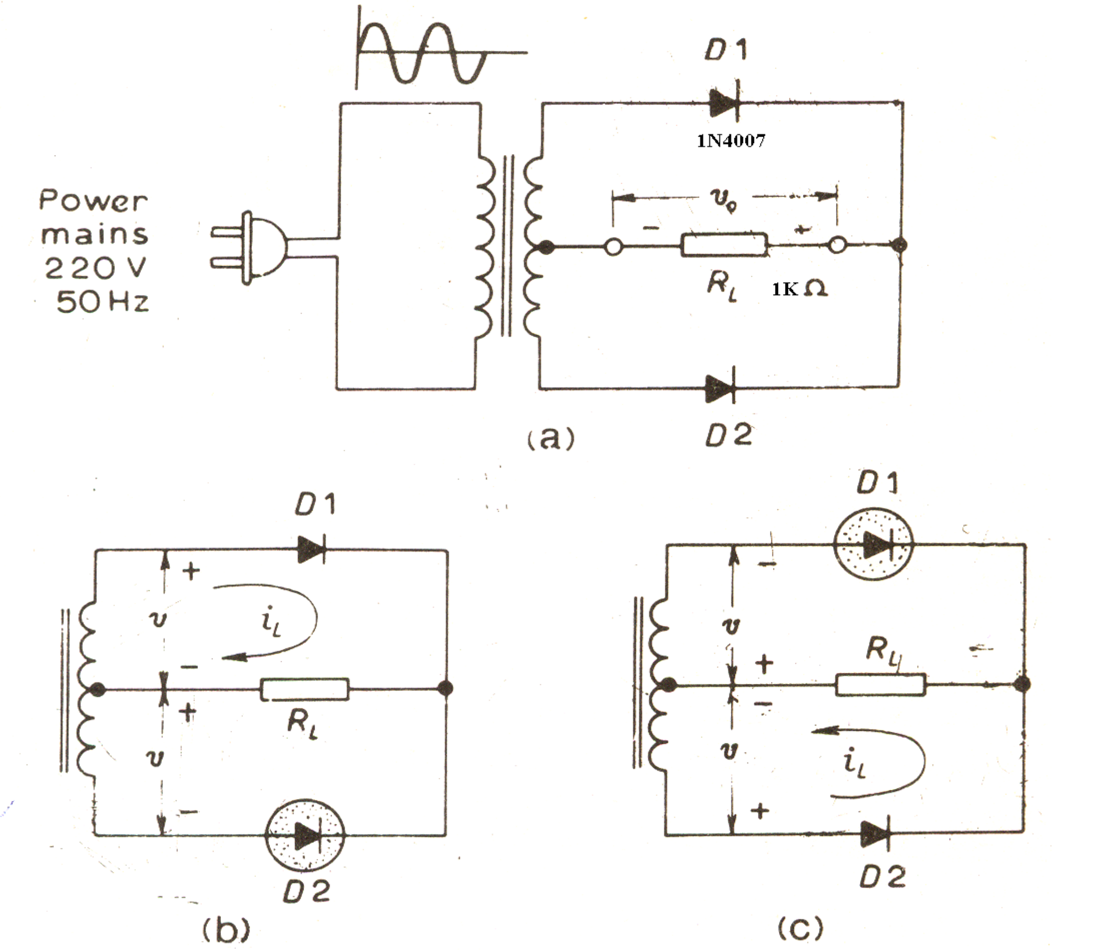
ii. COMPONENTS REQUIRED:

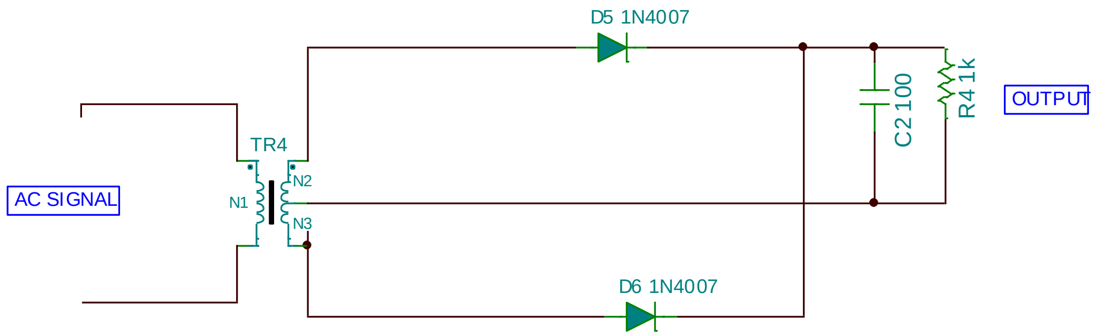
1. Capacitor (100µF)
2. Diode (1N4007)
3. Resistor (1kΩ)

3. THEORY:

During positive half cycle Diode D1 is forward biased and diode D2 is reversed biased so current conducts through D1 due to which voltage is developed across the load resistance. and During negative half cycle Diode D2 is forward biased and diode D1 is reversed biased so current conducts through D2 due to which voltage is developed across the load resistance.

4. CIRCUIT DIAGRAM:





5. PROCEDURE:

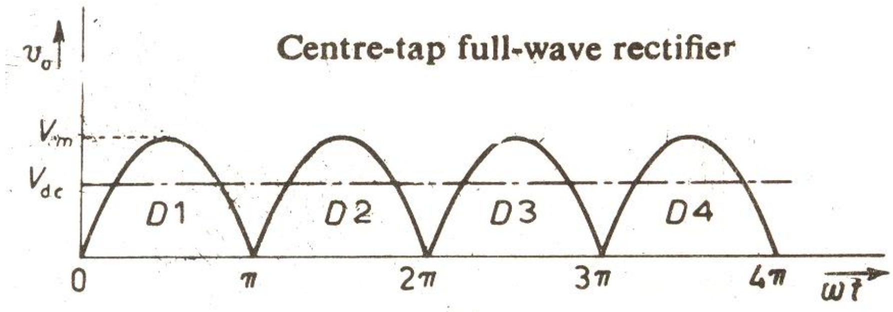
Without filter:

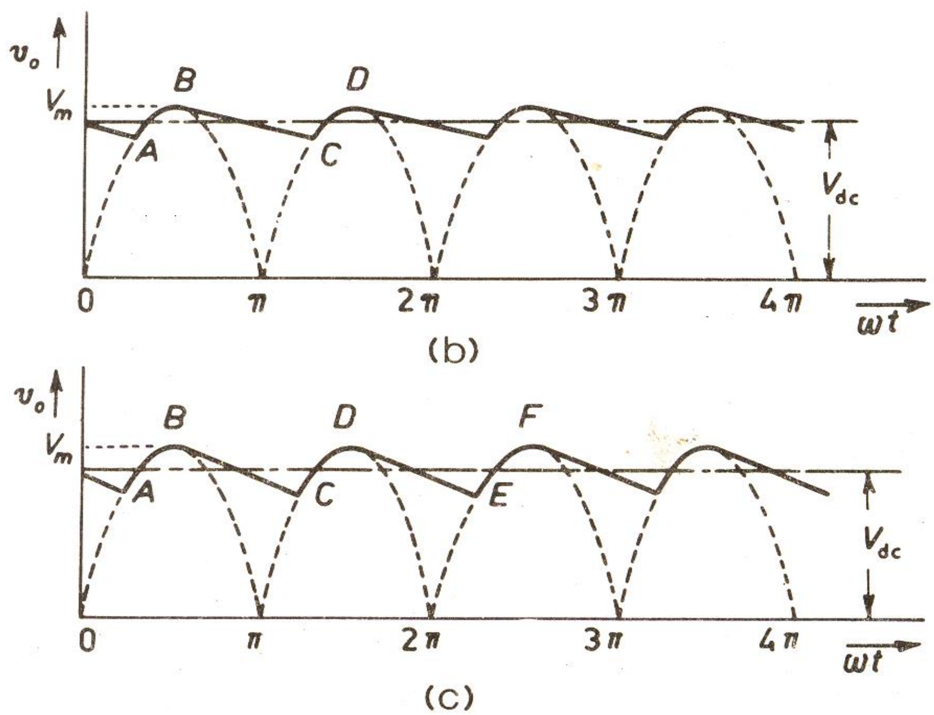
1. Connect the circuit as per the circuit diagram
2. Observe the voltage wave form across the secondary of the transformer and also across the output in CRO.
3. Measure ac voltage, dc voltage, no load and full load voltages with DMM.

With filter:

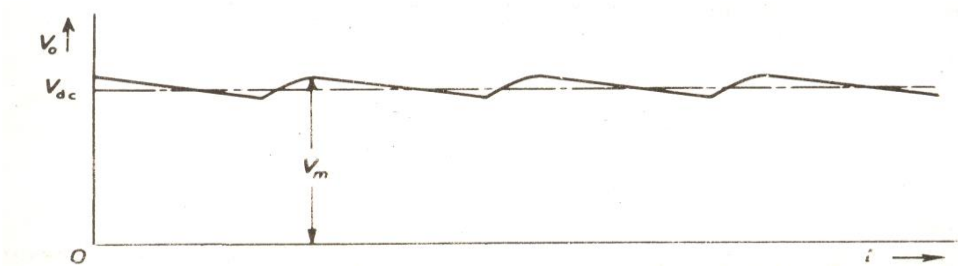
1. Connect the circuit as per the circuit diagram
2. Do not connect the capacitor, first get the circuit is verified.
3. Observe the voltage wave form across the secondary of the transformer and also across the output in CRO Connecting the capacitor.
4. Measure ac voltage, dc voltage, no load and full load voltages with DMM.

Graph:





Full-wave rectifier with shunt capacitance filter



6. OBSERVATIONS

Without filter:

Ac voltage= no load voltage=
Dc votage= full load voltage=

With filter:

Ac voltage= no load voltage=
Dc votage= full load voltage=

7. INFERENCE

As diode can be used as a switch so it is used in rectifier circuit to convert AC signal to DC signal, but not perfect DC it is pulsating DC.

8. PRECAUTIONS

1. Waveforms should be observed on CRO keeping in DC mode.
2. Use digital meter instead of analog meter.

9. TROUBLE SHOOTINGS

No meter reading then check if there are any loose connection.

10. RESULT:

Ripple factor = ac voltage/dc voltage = ____________________

$$\text{Percentage regulation } = \frac{V_{noload} - V_{fullload}}{V_{fullload}} x100\% = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

11. EXTENSSION

Efficiency of the circuit is less so we go for fullwave rectifier.

12. APPLICATIONS

1. Used to convert AC signal to pulsating DC.
2. Clippers.

13. QUESTION

1. Explain the operation of half wave rectifier.
2. Derive rms & avg value of output of full wave rectifier.
3. Derive ripple factor of full wave rectifier.
4. Derive efficiency of full wave rectifier
5. What is peak factor, form factor of full wave rectifier?
6. What is TUF of full wave rectifier?
7. What should be PIV of diode in full wave rectifier?

7. CLASS-A POWER AMPLIFIER

<u>AIM</u>: To study the operation of Class-A power amplifier and find out the efficiency of the amplifier for a given load

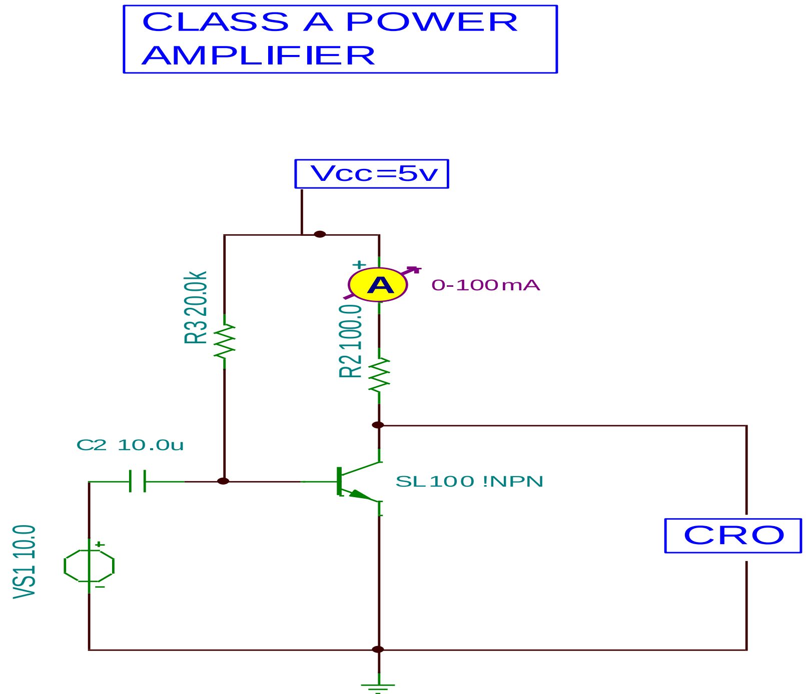
APPARATUS REQUIRED:

1. Class-A power amplifier trainer
2. Power meter
3. CRO
4. 0- 200 mA DC Ammeter…1 No

THEORY:

In class-A operation, the transistor stays in the active region and conducts for full 360^0 of the input cycle. The output signal varies for full 360 cycle of the input. In this case, the Q point is biased almost at the half of the DC load line. A class-A, amplifier, with the DC bias at one half of the supply voltage uses a good amount of power to maintain bias even with no signal applied. This results in very poor efficiency. When very little ac power is delivered to the load a large amount of power is dissipated in the collector resistance and transistor. This results in a maximum efficiency of only 30% by replacing the collector resistance by a inductor, the maximum efficiency can be increased to 50%. A practical transformer coupled class-A amplifier is shown in below figure. Resistors R1,R2 and Re maintains the biasing to the transistor Q1 and primary winding of the transformer is connected in the collector circuit and output has been taken from secondary winding.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Take the trainer and trace the given circuit and note down the values of all the components.
2. Switch on the trainer and verify the output of the regulated power supply i.e. +12V.
3. Connect Ammeter in the circuit with proper polarities.
4. Feed the ac signal of 60mV at the input. Keep the frequency at 3 KHz.
5. Connect power meter and CRO at the output of the amplifier, and select power meter impedance to 3 Ohm. See the wave shape of the output voltage on the CRO. Increase the input signal voltage till the output wave shape starts getting distorted. Note this input-signal voltage. Now reduce the input signal to a value slightly below this voltage.
6. In this condition measure and note down the current meter reading as **I dc** and output power meter reading as **Pac**.
7. Calculate the input dc power. Input dc power **Pdc = Vcc X I dc**
   Where Vcc = 12V and I dc = current meter reading

Find out the collector efficiency, % Efficiency = (AC Output power (Pac) / DC Input power (Pdc)) x 100.