BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB MANUAL

B.TECH
2ND SEMESTER

DEPARTMENT OF ELECTRICAL ENGINEERING

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Experiment No.1
Resistor Color Code

Aim
1. To learn Resistor Color Code
2. To determine the stated value of a resistor by interpreting the color code indicated on the resistor.

Apparatus
1. Set of wires.
2. Carbon Resistors.
3. Multi meter.

Theory
There are two ways to find the resistance value of a resistor. The color bands on the body of the resistor tell how much resistance it has. As shown in the following diagrams figure (1), there are 5-band resistors and 4-band resistors. Form both 5- and 4-band resistors, the last band indicates tolerance in table (1). Consult with the “Resistor Tolerance” in table (2) chart for finding the tolerance value.

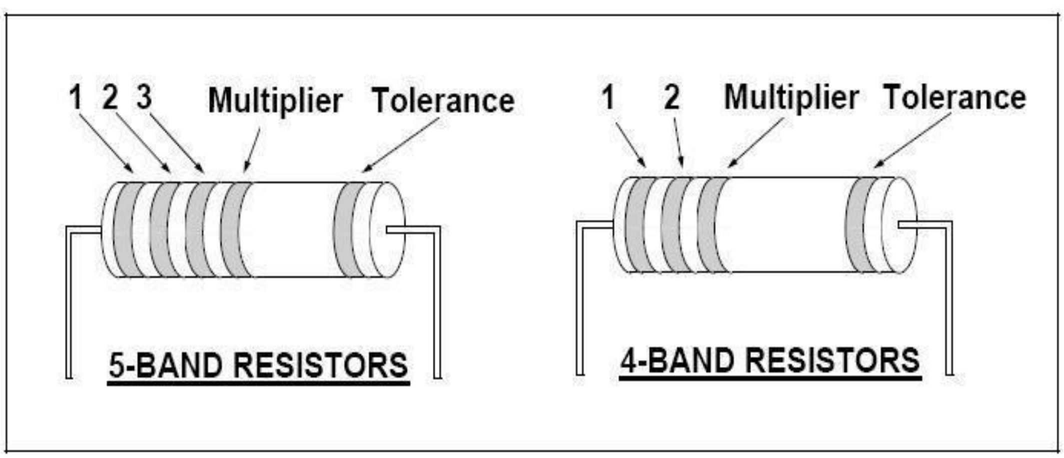


Fig.(1) 5- Band and 4- Band resistors

The first method for read resistor colors in Fig.(2)

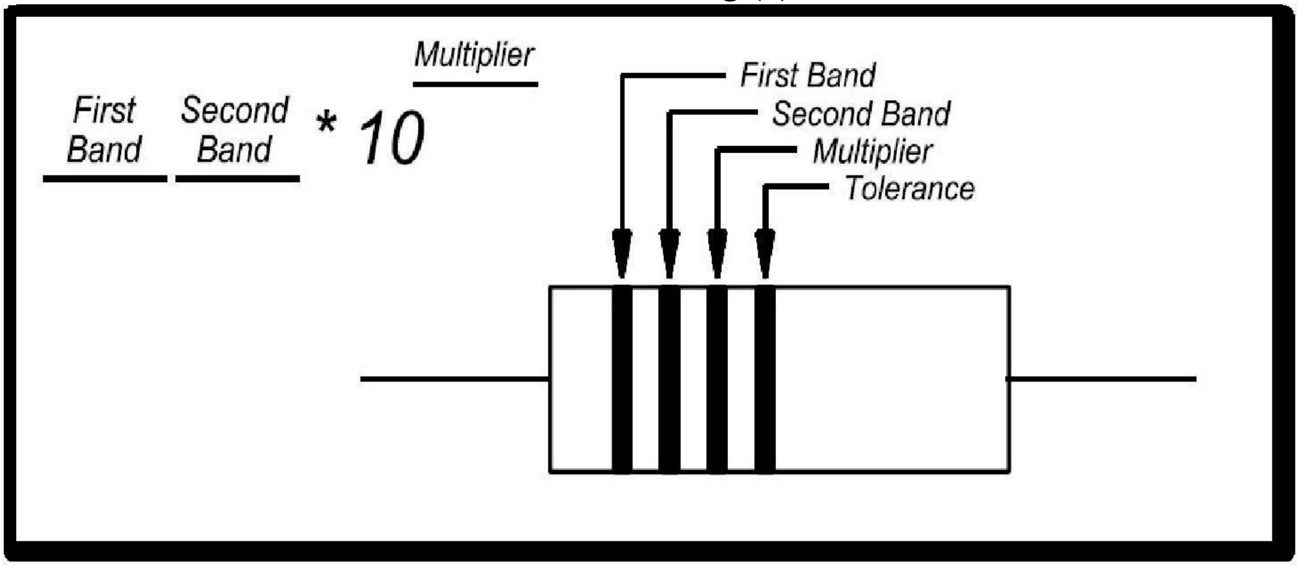


Fig.(2) First method read resistor

COLOR	FIRST BAND	SECOND BAND	MULTIPLIER	TOLERANCE
BLACK		0	$10^0 = 1$	
BROWN	1	1	$10^1 = 10$	
RED	2	2	$10^2 = 100$	
ORANGE	3	3	$10^3 = 1000$	
YELLOW	4	4	$10^4 = 10000$	
GREEN	5	5	$10^5 = 100000$	
BLUE	6	6	$10^6 = 1000000$	
VIOLET	7	7	$10^7 = 10000000$	
GREY	8	8	$10^8 = 100000000$	
WHITE	9	9	$10^9 = 1000000000$	
GOLD			$10^{-1} = 0.1$	5%
SILVER			$10^{-2} = 0.01$	10%
NO COLOR				20%

The first letter word to represent color resistor code in table (1)

Better **B**e **R**eady **O**r **Y**our **G**reat **B**ig **V**enture **G**oes **W**rong, **G**o **S**tudy **N**ow

Color	Tolerance
Silver	± 10%
Gold	± 5%
Red	± 2%
Brown	± 1%
Green	± 0.5%
Blue	± 0.25%
Violet	± 0.1%
Gray	± 0.05%

Table (2) Resistor Tolerance

View the resistors and based on the color bands determine its value. Below is an example:

Table 2-1		
Band	Color Code	Numeric Value
1st Band	Brown	1
2nd Band	Black	0
3rd Band	Orange	10^3
4th Band	Gold	±5%
The Resistor Value is 10K		**The tolerance is ±5%**

The first band is a one (1), the second band is a zero (0), and the multiplier band or third band is

one time text to the third power ( ) or one thousand (1000). Multiply 10 times 1000.

Another way to tell the resistance value of a resistor is to actually measure it with the ohmmeter. The explanation of how to measure the resistance is given in the later tip.

Where:-

$R_{max} = R+(R * T)$

Procedure

1. Measure and record twenty resistors with value of 1 Kohm.
2. Find the R max. , R min. then calculate the percentage error.
3. Repeat the steps (1,2) with resistor value of 10K ohm.
4. Repeat the steps (1,2) with resistor value of 100K ohm.

Observation

1. Comment for your results.
2. Determine the value and tolerance of the 10 resistors as shown in the following tables for chart fig. (3):

Table 2-2		
Band	Color Code	Numeric Value
1st Band	Orange	
2nd Band	Orange	
3rd Band	Orange	
4th Band	Silver	
The Resistor Value is__________		The Tolerance is _____%

Table 2-3		
Band	Color Code	Numeric Value
1st Band	Orange	
2nd Band	Orange	
3rd Band	Red	
4th Band	Silver	
The Resistor Value is__________		The Tolerance is _____%

Table 2-6		
Band	Color Code	Numeric Value
1st Band	Red	
2nd Band	Violet	
3rd Band	Brown	
4th Band	Gold	
The Resistor Value is____________		**The Tolerance is _____%**

Table 2-7		
Band	Color Code	Numeric Value
1st Band	Brown	
2nd Band	Brown	
3rd Band	Red	
4th Band	Gold	
The Resistor Value is____________		**The Tolerance is _____%**

Table 2-8		
Band	Color Code	Numeric Value
1st Band	Yellow	
2nd Band	Violet	
3rd Band	Red	
4th Band	Silver	
The Resistor Value is____________		**The Tolerance is _____%**

Result:

Hence the color coding of resistor has been Verified and the values has been

EXPERIMENT NO: 2

P-N JUNCTION DIODE CHARACTERISTICS

Aim: To plot Volt-Ampere Characteristics of Silicon P-N Junction Diode.

Apparatus:

S.no	Apparatus	Type	Range	Quantity
1	PN Junction diode kit	-		1
2	RPS	-	0-30 v	1
3	Ammeter	-	(0-30)mA,(0-500)micro Amps	1
4	Voltmeter	-	(0-1)v,(0-30)v	1
5				
6				

Theory:

The term bias refers to the use of a dc voltage to establish certain operating conditions for an electronic device. Depending on the magnitude and polarity of the applied voltage the diode is said to be:

Forward Biased, Anode voltage is greater than the Cathode voltage

Reverse Biased, Cathode voltage is greater than the Anode voltage

So, diode is a simple switch that is either closed (conducting) or open (non conducting). Specifically, the diode is a short circuit, like a closed switch, when voltage is applied in the forward direction, and an open circuit, like an open switch, when the voltage is applied in the reverse direction.

Let us now take the earlier model one more step. The offset voltage model adds the barrier potential to the ideal switch model. When the diode is forward biased it is equivalent to a closed switch in series with a small equivalent voltage source equal to the barrier potential (0.7 V for Silicon, 0.4 for germanium) with the positive side towards the anode. When the diode is reverse biased, it is equivalent to an open switch just as in the ideal model.

When forward biased, Vg (0.7 for Silicon and 0.4 for Germanium) volts appears across the diode and current flows.

During reverse bias, when the voltage applied across the diode is less than Vg, there will be no current flowing.

Let us now take the earlier model one more step. It is the most accurate of the diode models. The Complete diode model of a diode consists of the barrier potential, the small forward dynamic resistance and the ideal diode. The resistor approximates the semiconductor resistance under forward bias. This diode model most accurately represents the true operating characteristics of the real diode.

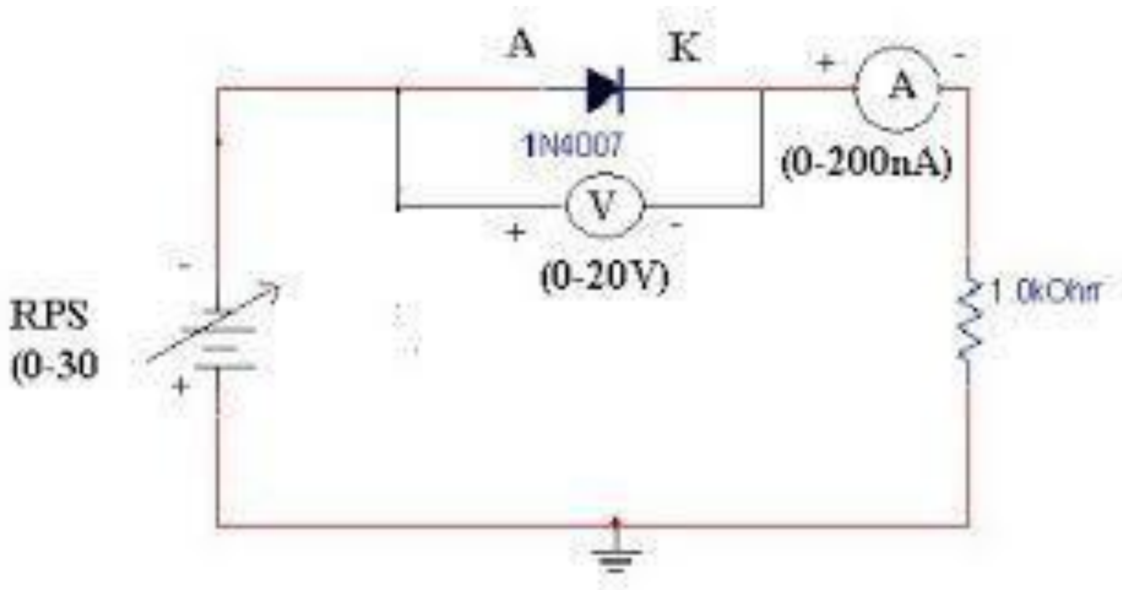
Static Resistance of a P-N junction diode is the ratio of forward voltage to forward current

Dynamic Resistance of a P-N junction diode is the small change in forward voltage to small change in forward current at a particular operating point.

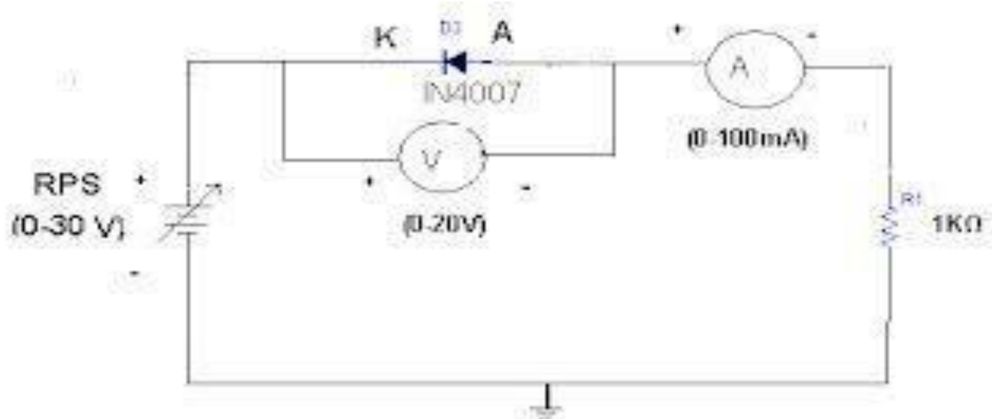
When a diode is reverse biased a leakage current flows through the device. This current can be effectively ignored as long as the reverse breakdown voltage of the diode is not exceeded. At potentials greater than the reverse breakdown voltage, charge is pulled through the p-n junction by the strong electric fields in the device and large reverse current flows. This usually destroys the device. There are special diodes that are designed to operate in breakdown. Such diodes are called zener diodes and used as voltage regulators.

Circuit Diagram:

Forwarad Bias:



Reverse Bias:



Procedure:

Forwarad Bias:

1. Connect the PN Junction diode in forward bias i.eAnode is connected to positive of the power supply and cathode is connected to negative of the power supply .

2. Use a Regulated power supply of range (0-30)V and a series resistance of 1kΏ.

3. For various values of forward voltage (Vf) note down the corresponding values of forward current(If) .

Reverse bias:

1. Connect the PN Junction diode in Reverse bias i.e; anode is connected to negative of the power supply and cathode is connected to positive of the power supply.

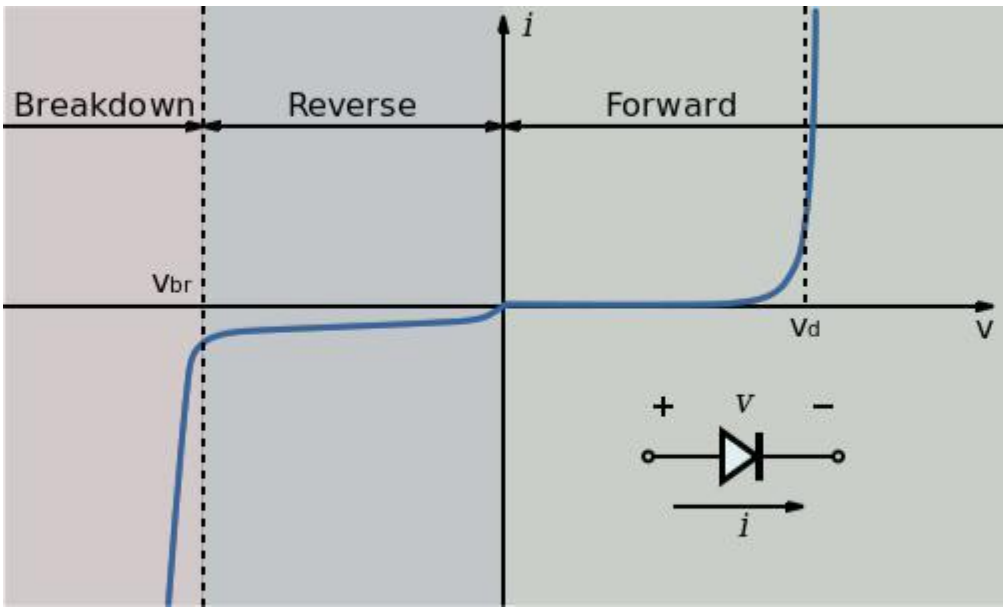
2. For various values of reverse voltage (Vr) note down the corresponding values of reverse current (Ir).

Tabular column:

Forward Bias:

Reverse Bias:

Graph:



Result:

Thus the VI characteristics of PN junction diode is verified.
Determined.

EXPERIMENT NO 3

Characteristics of zener diode (Forward & Reverse Bias)

Aim of the Experiment:

To study characteristics of zener diode in both forward and reverse bias condition.

Equipments & Components Required:

1. Resistors - 1KΩ
2. Zener Diode
3. Regulated power supply.
4. Connecting wires.
5. Ammeter and Multimeter.

Theory:

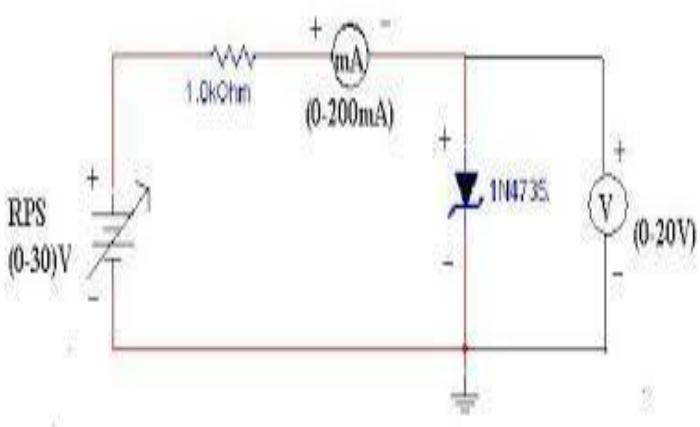
A Zener diode is a diode which allows current to flow in the forward direction in the same manner as an ideal diode, but will also permit it to flow in the reverse direction when the voltage is above a certain value known as the breakdown voltage, "zener knee voltage", "zener voltage" or "avalanche point".

A conventional solid-state diode will allow significant current if it is reverse-biased above its reverse breakdown voltage. When the reverse bias breakdown voltage is exceeded, a conventional diode is subject to high current due to avalanche breakdown. Unless this current is limited by circuitry, the diode will be permanently damaged due to

overheating. A zener diode exhibits almost the same properties, except the device is
specially designed so as to have a reduced breakdown voltage, the so-called zener voltage.
By contrast with the conventional device, a reverse-biased zener diode will exhibit a
controlled breakdown and allow the current to keep the voltage across the zener diode
close to the zener breakdown voltage. For example, a diode with a zener breakdown voltage
of 3.2 V will exhibit a voltage drop of very nearly 3.2 V across a wide range of reverse
currents. The zener diode is therefore ideal for applications such as the generation of a
reference voltage (e.g. for an amplifier stage), or as a voltage stabilizer for low-current
applications.

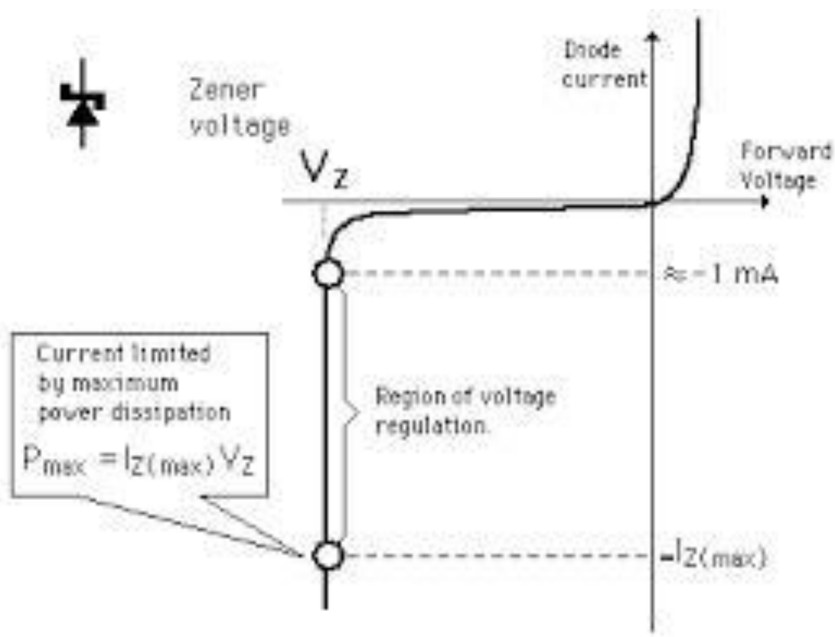
Circuit Diagram:

Forward Biased Junction Diode



Reverse Biased Junction Diode

Zener diode characteristics



Procedure:

1. Before doing the connection, check all the components and equipments.
2. Make the connection as shown in the circuit diagram.
3. Vary the applied voltage in both forward and reverse bias as given in the data table.
4. Record forward and reverse currents in both forward and reverse conditions.
5. Plot a graph for both forward and reverse bias conditions by taking voltage

along
the X-axis and current along Y-axis

Tabular Column:

Forward Bias:

Reverse Bias:

Result:

Hence the V-I characteristic of Zener diode is verified.

EXPERIMENT NO -4

Verification of ohm's law

Aim: To study the dependence of current on the potential difference across a resistor and determine its resistance. Also plot a graph between V and I.

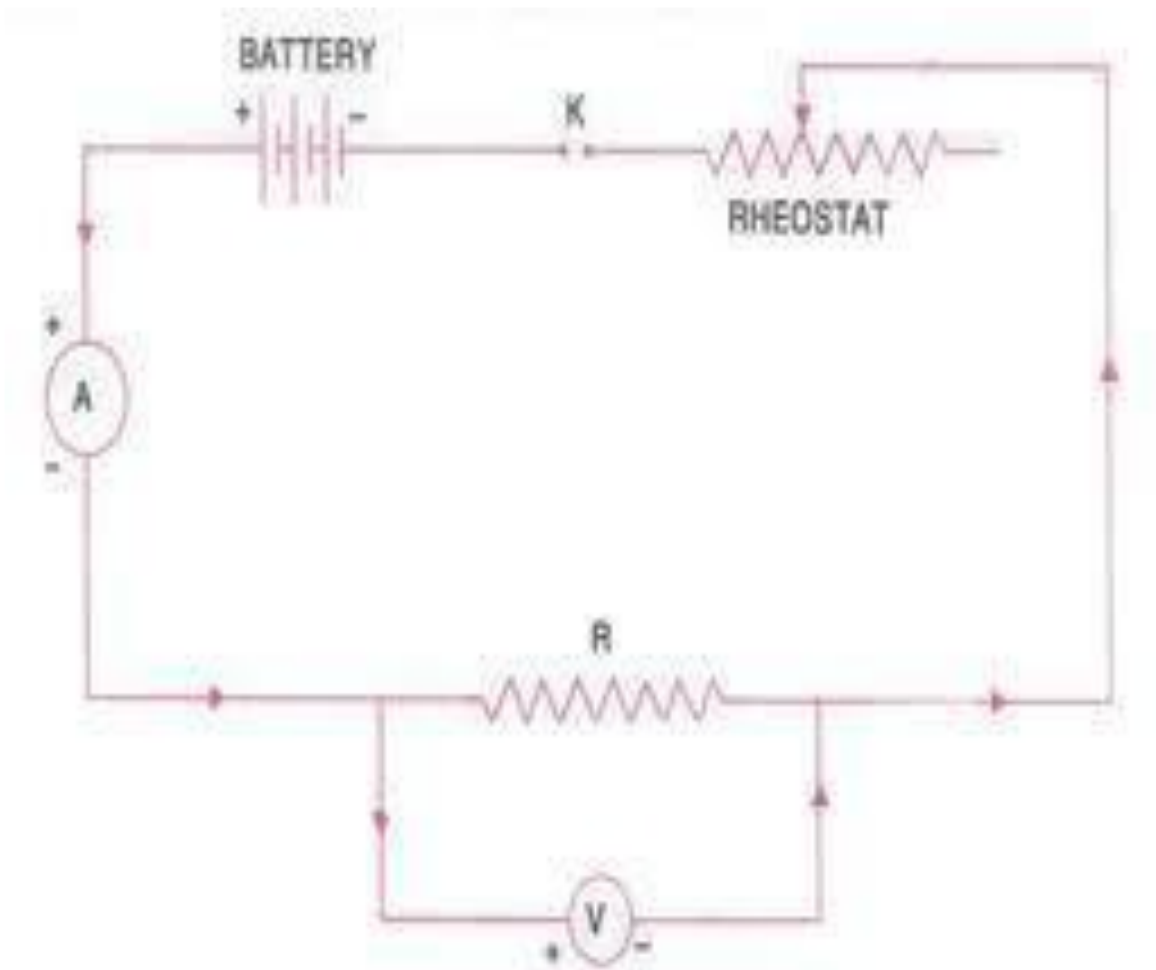
Apparatus Required:

1. Rheostat
2. Regulated power supply.
3. Connecting wires.
4. Multimeter.

Theory:

The Ohm's law states that the direct current flowing in a conductor is directly proportional to the potential difference between its ends. It is usually formulated as $V = IR$,
where V is the potential difference, or voltage, I is the current, and R is the resistance of the conductor.

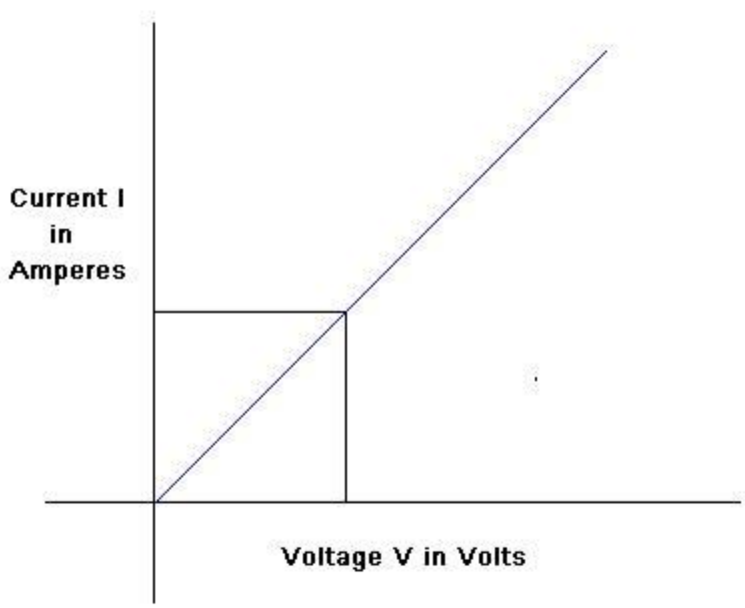
Circuit Diagram:



Tabular column:

s.no	Voltage Reading in volts	Current Reading in amps	Resistance=V/I in ohm
1			
2			
3			
4			
5			
6			
7			
8			
9			

Graph:



Procedure:

1. Before doing the connection, check all the components and equipments. 2. Make the connection as shown in the circuit diagram.

3. Keep value of Rheostat 1 KΩ and start first set of ten trials.
4. Vary voltage applied across R from 1V to 10V and record corresponding values of current from the ammeter.
5. Also calculate theoretical values of current using ohm's law and record in the data table.
6. Observe the difference between theoretical and practical values of current.
7. Repeat from step 3 by keeping value of Rheostat to 2 K Ohm.

Results: The study of dependence of current on the potential difference across a resistor has been determined. Also plot a graph between V and I.

EXPERIMENT NO :- 5 1

Aim :- To illustrate the working of AND, OR & NOT Gate.

Apparatus Required :- Logic gates ; AND gate, OR gate, NOT gate, connecting probes.

Theory :-

AND gate - An AND gate is an all or nothing gate. It has two or more inputs but only 1 output. All i/ps must be high to provide a high o/p. It means that the o/p will be high if & only if all the i/ps are high, otherwise if any of i/p is low then the o/p will be low. It is usually written as

$Y = A \cdot B$
$= A \text{ AND } B$

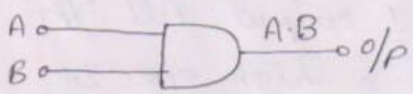
OR gate - An OR gate is an any or all gate. It has two or more i/ps but only 1 o/p. If any one of the i/p is high the o/p of OR gate will also be high. The only criteria for getting a low o/p is that all of its i/p is low. It is usually written as, $Y = A + B$

NOT gate - The NOT circuit or NOT gate or inverter performs a basic logic funⁿ called invertion or complimentation. The purpose of the inverter is to change 1 logic level to the opposit level.

In terms of bits, it changes 1 into 0 & 0 into 1 o/p. NOT gate is called the inverter because o/p state is always o/p to the i/p state. So, when the i/p is low signal o/p signal is high & vice-versa.

It is called NOT gate because the o/p state is always opposit of i/p state.

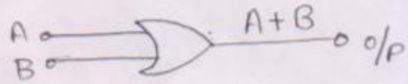
AND gate



Truth table

A	B	o/p
0	0	0
0	1	0
1	0	0
1	1	1

OR gate



Truth table

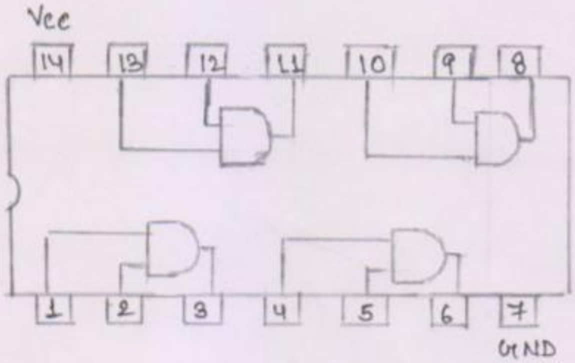
A	B	o/p
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate

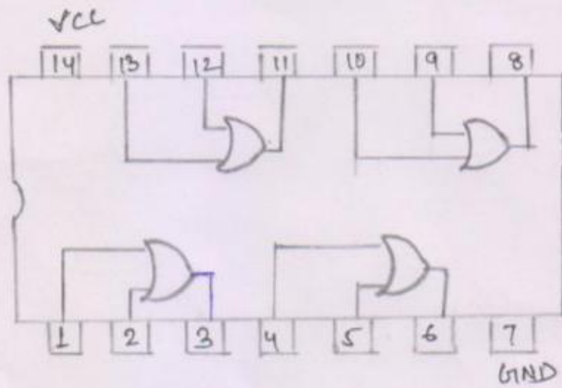
Truth table

i/p	o/p
0	1
1	0

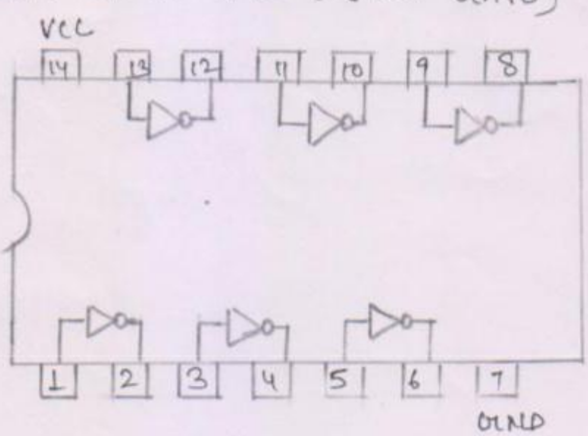
PIN DIAGRAM OF IC 7408 (AND GATE)



PIN DIAGRAM OF IC 7432 (OR GATE)



PIN DIAGRAM OF IC 7404 (NOT GATE)



2

Procedure :- 1.) Make the connection as per circuit diagram.

2.) Switch on the power supply.

3.) Take two i/ps from the i/p part

4.) Provide this i/p to the i/ps of the AND gate.

5.) Take o/p from AND gate & connect it to LED display.

6.) check o/p for all 2 i/ps combination by switching the i/ps.

7.) Provide i/p to i/ps of OR gate.

8.) Take o/p from OR gate & connect it to LED display.

9.) check o/p for all 2 i/ps. combination by switching the i/p.

10.) Take one i/p & connect it into i/p of NOT gate.

11.) Take o/p from NOT gate & connect it to LED display.

12.) Repeat this procedure for various no. of i/ps.

Observation :- For AND Gate :-

When, A = 0, B = 0, o/p = 0
A = 0, B = 1, o/p = 0
A = 1, B = 0, o/p = 0
A = 1, B = 1, o/p = 1

For OR gate:

when, A = 0 , B = 0 , o/p = 0
A = 0 , B = 1 , o/p = 1
A = 1 , B = 0 , o/p = 1
A = 1 , B = 1 , o/p = 1

For NOT gate

when , i/p = 1 , o/p = 0
i/p = 0 , o/p = 1

Result :- The function of the three basic gates , i.e AND , OR & NOT gate have been verified.

EXPERIMENT NO :- 6. 3

Aim:- To illustrate De-morgan's theorem using Basic Logic gates.

Apparatus Required:- Various IC's containing AND gate, OR gate & NOT gate, connecting probes.

Theory :-

De-morgan's theorem –

1) $\overline{A \cdot B} = \overline{A} + \overline{B}$
2) $\overline{A + B} = \overline{A} \cdot \overline{B}$

This theorem states that the compliment of the sum of two or more variable is equal to the product of compliments of the variables. i.e the compliment of two or more variabes ORed in the same AND of the compliments of each individual variable.

Also the compliment of the product of two or more variable is equal to the sum of compliments of the variable i.e the compliment of two or more variable ANDed in the same as the ORed of the compliment of each individual variables.

Procedure :- 1) Make the connections as per circuit diagram.

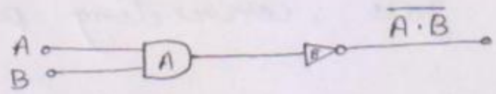
2) Take two i/ps from i/p slot of the kit.

3) Provide this i/p to gate A & as well as NOT gate C & D.

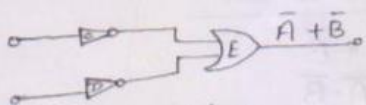
4.) check the o/p of circuit 1 & circuit 2 for i/p combination 00, 01, 10 & 11.

5.) Provide the inputs to OR gate F as well as NOT gate H & I.

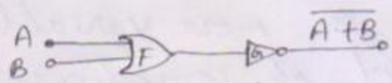
6.) check the o/ps of circuit 3 & 4 for i/p combination 00, 01, 10 & 11.



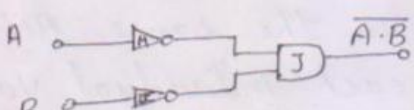
ckt-1



circuit 2



circuit-3



circuit-4

observation :- for circuit 1 & circuit 2

when, $A=0,\ B=0,\ \overline{A \cdot B}=1,\ \bar{A}+\bar{B}=1$

$A=0,\ B=1,\ \overline{A \cdot B}=1,\ \bar{A}+\bar{B}=1$

$A=1,\ B=0,\ \overline{A \cdot B}=1,\ \bar{A}+\bar{B}=1$

$A=1,\ B=1,\ \overline{A \cdot B}=0,\ \bar{A}+\bar{B}=0$

For circuit 3 & circuit 4

when, $A=0,\ B=0,\ \overline{A+B}=1,\ \bar{A} \cdot \bar{B}=1$

$A=0,\ B=1,\ \overline{A+B}=0,\ \bar{A} \cdot \bar{B}=0$

$A=1,\ B=0,\ \overline{A+B}=0,\ \bar{A} \cdot \bar{B}=0$

$A=1,\ B=1,\ \overline{A+B}=0,\ \bar{A} \cdot \bar{B}=0$

4

Hence, we can see that for every combination in circuit 1 & circuit 2 $\overline{A \cdot B}$ is always equal to $\bar{A} + \bar{B}$ & in circuit 3 & circuit 4, $\overline{A + B}$ is always equal to $\bar{A} \cdot \bar{B}$.

<u>Result</u> :- Hence, both the laws of De-morgan's theorem has been illustrated & Verified.

EXPERIMENT : 7.

AIM: To observe Sine wave, Square wave, triangular wave on the CRO and to measure amplitude and frequency of the wave form.

APPARATUS REQUIRED:-

Function Generator
CRO
connecting probe.

THEORY:-

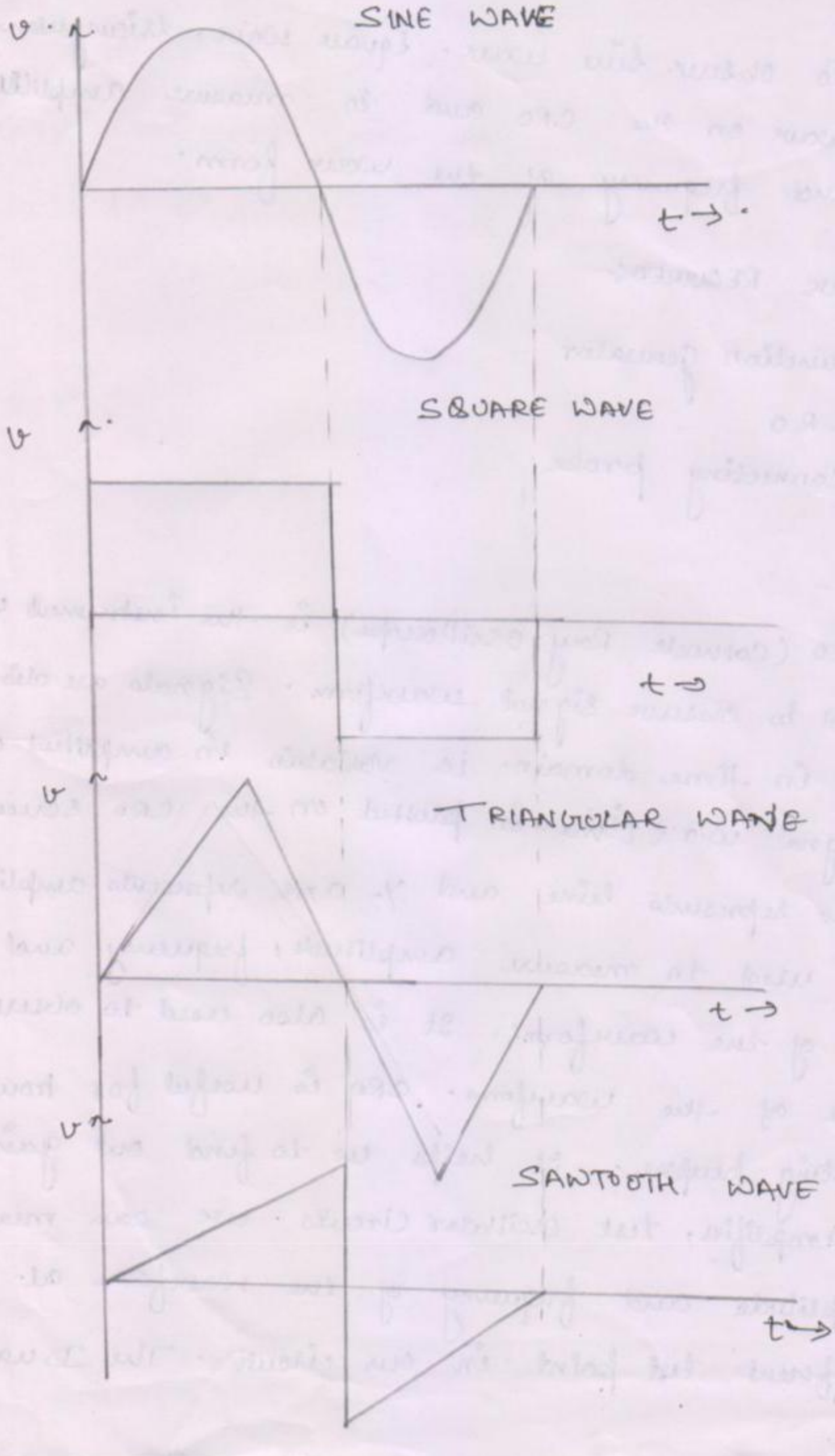
CRO (Cathode Ray Oscilloscope) is the instrument which is used to observe signal waveform. Signals are displayed in time domain. ie variation in amplitud of the signal w.r.t time. is plotted on the CRO screen. x- axis represents time and y- axis represents amplitude. It is used to measure amplitude, frequency and phase of the waveforms. It is also used to observe shape of the waveform. CRO is useful for trouble-shooting purpose. It helps us to find out gain of amplifier, test oscillator Circuits. we can measure amplitude and frequency of the waveform at different test point in our circuit. The Dual channel CRO X-Y mode is available.

Latest digital storage oscilloscope display voltage and frequency directly on the LCD and does not require any calculations. It can also store waveform for further analysis.

PROCEDURE:

1) Connect function generator output at the input of CRO at channel 1 or at channel 2.
2) Select proper channel ie if signal is connected to channel 1. Select CH1 & if signal is connected to channel 2 select CH2.
3) Adjust Time/Div knob to get sufficient time period displacement of the wave on the CRO screen.
4) With fine tuning of time/Div make the wave form steady on screen.
5) Use triggering controls if waveform is not stable.
6) Keep Volt/Div knob such that waveform is visible on the screen without clipping.
7) Measure P-P reading along Y-axis. This reading multiplied with Volt/Div gives peak to peak amplitude of the ac input wave.
8) Measure horizontal division of one complete cycle.

WAVEFORM


SINE WAVE
v
t →
SQUARE WAVE
v
t →
TRIANGULAR WAVE
v
t →
SAWTOOTH WAVE.
v
t →

This division multiplied by time / div gives time period of the input wave.

9) Calculate frequency using formula $f = 1/T$.

10) Note down readings in the observation table

11) Draw waveform of sine, square, ramp and triangular wave on graph sheet.

OBSERVATION

Function	Vertical division (a)	Volt/div (b)	Amplitude (P-P) $V = a \times b$	Horizontal div (c)	Time/div (d)	freq $F = 1/T$
Sine wave.						
Square wave.						
Triangular wave.						
Sawtooth or Ramp wave.						

RESULT:- Hence the waveform of sine wave, square wave triangular & Ramp wave has been observed & drawn.