Experiment No. 03

Aim: - To verify the Kirchoff's current and voltage laws.

GOAL: -

1) To estimate current in different branches of electric circuit.

2) To determine Kirchhoff's laws.

APPARATUS: -

Sr. No.	List of equipment	Range	Qty.
1	Voltmeter		
2	Ammeter		
3	Resistors		
4	D.C. Supply		
5	Connecting Wires		

THEORY:-

Kirchhoff's First Low (KCL)

It is also known as Kirchhoff's current law (KCL).It is stated as follows:

"In an electrical circuit, at any point of time, the algebraic sum of the current in the entire Conductor meeting at any point is zero."

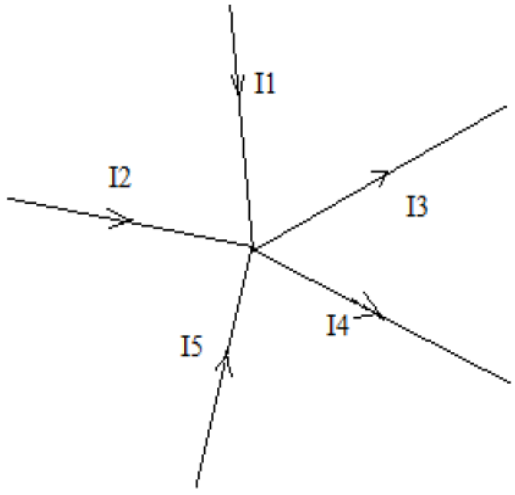

Figure 1

In other words, whenever two or more conductors meet at a point then the sum of the current Flowing towards the junction point is equal to the sum of current flowing away from it. Consider

figure 1 here I_1, I_2, I_5 are entering the junction so they are assigned positive sign. Current I_3 and I_5 are leaving the junction so they are assigned negative sign.

Applying KCL,

$$I_1 + I_2 - I_3 - I_4 + I_5 = 0$$

$$I_1 + I_2 + I_5 = I_3 + I_4$$

Or sum of the incoming current = sum of outgoing currents

KCL is based on the law of conservation of charge which states that the net charge flowing into a Node is equal to the net charge flowing out of the node. i.e. There can be no accumulation of Charge at any point.

Kirchhoff's Second Law (KVL)

It is also known as Kirchhoff's Voltage Law (KVL). It is stated as follows:

"The algebraic sum of the products of the current and resistance of each conductor in any closed path in any closed path in a network plus the algebraic sum of the voltages in that path is zero."

i.e. $\Sigma IR + \Sigma V = 0$

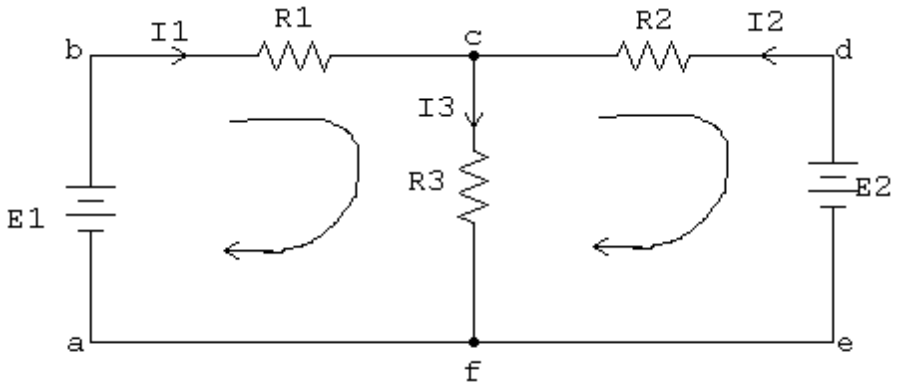

Figure 2

Before writing the KVL equation for the circuit shown in figure 2 let we understand the sign convention necessary for analyzing the circuit.

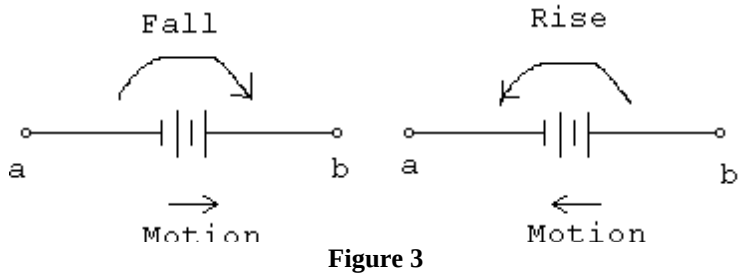

Figure 3

From a to b – VS, From b to a + VS

The polarity of a voltage source is fixed and is independent of the direction of the current. The Positive (+) terminal is at higher potential and negative (-) terminal is at lower potential.

Thus in figure 3 if we move from a to b i.e. from '+' terminal to the '-' terminal there is a voltage drop denoted by $-V_S$. If, we move from b to a i.e. from '-' terminal to the '+' terminal there is a voltage rise denoted by $+ V_S$.

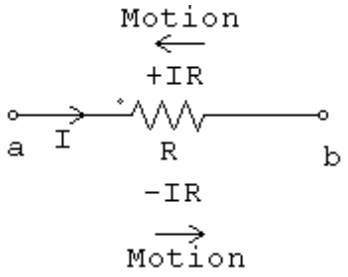

Figure 4

Current flows from a point of higher potential to a point of lower potential in figure 4 current I flow from point A to B. Hence point A is at higher potential and point B is at lower potential. When we move from A to B, we are moving along the direction of current, there is a voltage drop $V_{AB} = - IR$. While going from B to A, we are moving against the flow of current, there is a rise in the voltage $V_{BA} = + IR$.

Now let us write the KVL equation for the circuit shown in figure 2. Mostly we choose the clockwise direction for traversing the closed

Path abcfa $-E_1-I_1R_1-I_3R_3 = 0$

Path cdefc $+I_2R_2-E_2+I_3R_3 = 0$

Since voltage is energy (or work) per unit charge, KVL is an alternative method of starting the law of conservation of energy.

CIRCUIT DIAGRAM: -

PROCEDURE:-

For Kirchhoff's current law

- Connect the circuit as per shown in diagram.
- Set the rheostat to their maximum position.
- Switch on the supply and adjust the voltage.
- Note the readings of ammeter A_1, A_2, A_3 in the observation table.
- Decrease the resistance of rheostat in steps.
- Note the readings of ammeter A_1, A_2, A_3 in the observation table.

For Kirchhoff's voltage law

- Connect the circuit as per shown in diagram.
- Set the rheostat to their maximum position.
- Switch on the supply and adjust the voltage.
- Note the readings of voltmeter V_1, V_2, V_3 in the observation table.
- Decrease the resistance of rheostat in steps.
- Note the readings of voltmeter V_1, V_2, V_3 in the observation table.

OBSERVATION TABLE: -

1. **For Kirchhoff's Current Law**

Sr. No.	**Supply Voltage**	**Current through R_2-I_2**	**Current through R_3- I_3**	**Current through R_1- I_1**	**Calculated $I_1 = I_2+I_3$**	**Remarks**
01						
02						
03						

2. **For Kirchhoff's Voltage Law**

Sr. No.	**Supply Voltage**	**Voltage across R_1-V_1**	**Voltage across R_1-V_2**	**Voltage across R_1- V_3**	**Calculated $V=V_1+V_2+V_3$**	**Remarks**
01						
02						
03						

CALCULATION: -

Conclusion:-