**Experiment No-4**

To implement and verify Kirchhoff voltage law and Kirchhoff current law.

**OBJECTIVE:**

Objective of this lab is to verify KVL and KCL.

**APPARATUS:**

1. Resistors
2. DC Power Supply
3. Digital Multimeter (DMM)
4. Connecting wires

**Introduction:**

A German Physicist “Robert Kirchhoff” introduced two important electrical laws in 1847 by which, we can easily find the equivalent resistance of a complex network and flowing currents in different conductors. Both AC and DC circuits can be solved and simplified by using these simple laws which is known as Kirchhoff’s Current Law (KCL) and Kirchhoff’s Voltage Law (KVL).

**Kirchhoff’s Current Law (KCL):**

According to KCL, at any moment, the algebraic sum of flowing currents through a point (or [junction](https://www.electricaltechnology.org/2013/12/determine-the-number-of-nodes-branches-loops-and-meshes-in-circuit.html)) in a network is Zero (0) or in any electrical network, the algebraic sum of the currents meeting at a point (or junction) is Zero (0). This law is also known as Point Law or Current law.

In any [electrical network](https://www.electricaltechnology.org/2014/01/important-terms-related-to-electric-circuits-and-networks.html), the algebraic sum of incoming currents to a point and outgoing currents from that point is Zero. Or the entering currents to a point are equal to the leaving currents of that point. In other words, the sum of the currents flowing towards a point is equal to the sum of those flowing away from it. Or the algebraic sum of the currents entering a node equals the algebraic sum of the currents leaving it.



Fig. 4.1

**Explanation of KCL:**

Suppose some conductors are meeting at a point “A” as shown in fig 4.1(a) in some conductors, currents are incoming to the point “A” while in other conductors, Currents are leaving or outgoing from point “A”.

Consider the incoming or entering currents as “Positive (+) towards point “A” while the leaving or outgoing currents from point “A” is “Negative (-)”.
then:



i.e.
Incoming or Entering Currents = leaving or Outgoing Currents
Or
ΣI Entering = ΣI Leaving

**Kirchhoff’s Voltage Law (KVL):**

The Kirchhoff’s second law stated that; In any closed path (or circuit) in a network, the algebraic sum of the IR product is equal to the EMF in that path.

In other words, in any closed loop (which also known as Mesh), the algebraic sum of the EMF applied is equal to the algebraic sum of the voltage drops in the elements. Kirchhoff’s second law is also known as Voltage Law or Mesh law.

ΣIR= ΣE

#### **Explanation of KVL:**

A closed circuit is shown in fig 4.2 which contains on two [connection of batteries](https://www.electricaltechnology.org/2013/11/series-parallel-and-series-parallel-connection-of-batteries.html) E1 and E2. The overall sum of E.M.F’s of the batteries is indicated by E1-E2. The imaginary direction of current is also shown in the fig.

E1 drive the current in such a direction which is supposed to be positive while E2 interfere in the direction of current (i.e. it is in the opposite direction of the supposed direction of current) hence, it is taken as negative. The voltage drop in this closed circuit is depends on the product of Voltage and Current.



Fig. 4.2

In the above fig, I1R1 and I2R2 is positive voltage drop and I3R3 and I4R4 are negative V.D.
If we go around the closed circuit (or each mesh), and multiply the resistance of the conductor and the flowing current in it, then the sum of the IR is equal to the sum of the applied EMF sources connected to the circuit.

The overall equation for the above circuit is:

E1-E2 = i1R1 + i2R2 – i3R3 – i4R4

If we go in the supposed direction of the current as shown in the fig, then the product of the IR is taken as positive otherwise negative.

**Direction of the Current:**It is very important to determine the direction of current whenever solving circuits via Kirchhoff’s laws.

The direction of current can be supposed through clockwise or anticlockwise direction. Once you select the custom direction of the current, you will have to apply and maintain the same direction for overall circuit until the final solution of the circuit. If we got the final value as positive, it means, the supposed direction of the current were correct. In case of negative values, the current of the direction is reversal as compared to the supposed one then.

**PROCEDURE**

**Part (a): Verification of KCL:**

1. Draw the circuit as shown in fig. 4.4.
2. Measure the resistors values using ohm-meter.
3. Give DC power supply.
4. Measure the total source current.
5. Measure the current flowing every resistor using ammeter.
6. Solved this circuit mathematically using KCL formulas.
7. Compare the results obtained in steps 4 & 5.



Fig. 4.4 Circuit for KCL

**Observation Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Is( Source Current) | IR1 | IR2 | IR3 | Is= IR1+ IR2+ IR3 |
|  |  |  |  |  |
|  |  |  |  |  |

**Part (b): Verification of KVL:**

1. Draw the circuit as shown in fig. 4.5.
2. Measure the resistors values using ohm-meter.
3. Give DC power supply.
4. Measure the voltage drop across every resistor using voltmeter.
5. Solved this circuit mathematically using KVL formulas.
6. Compare the results obtained in steps 4 & 5.



Fig. 4.5 Circuit for KVL

**Observation Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Vs( Input Voltage) | VR1 | VR2 | VR3 | Vs= VR1+ VR2+ VR3 |
|  |  |  |  |  |
|  |  |  |  |  |

Conclusion:

Comments:8888888888888