SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: 23BMT201 & Circuit Analysis

I Year : II Semester

Unit I –DC AND AC CIRCUITS ANALYSIS

Topic : Kirchhoff's Voltage and Current Law

Kirchhoffs Circuit Law

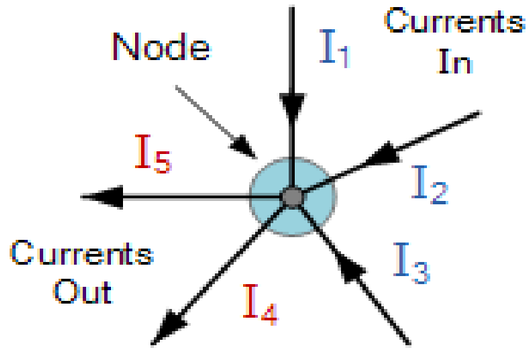
•Kirchhoff’s Circuit Laws allow us to solve complex circuit problems by defining a set of basic network laws and theorems for the voltages and currents around a circuit.

•German physicist, Gustav Kirchhoff developed a pair or set of rules or laws which deal with the conservation of current and energy within electrical circuits.

•These two rules are commonly known as: Kirchhoff’s Circuit Laws with one of Kirchhoff’s laws dealing with the current flowing around a closed circuit, **Kirchhoff’s Current Law, (KCL)** while the other law deals with the voltage sources present in a closed circuit, **Kirchhoff’s Voltage Law, (KVL).**

Kirchhoff's Current Law

•Kirchhoff's Current Law or KCL, states that the "total current or charge entering a junction or node is exactly equal to the charge leaving the node as it has no other place to go except to leave, as no charge is lost within the node". In other words the algebraic sum of ALL the currents entering and leaving a node must be equal to zero, $I_{(exiting)} + I_{(entering)} = 0$.

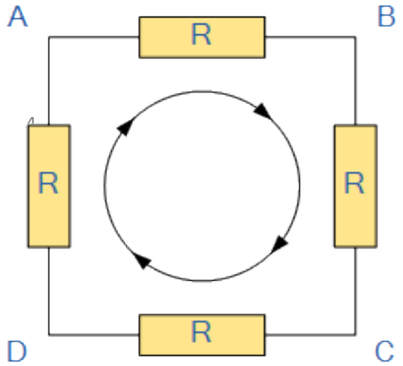


$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

Kirchhoff's Voltage Law

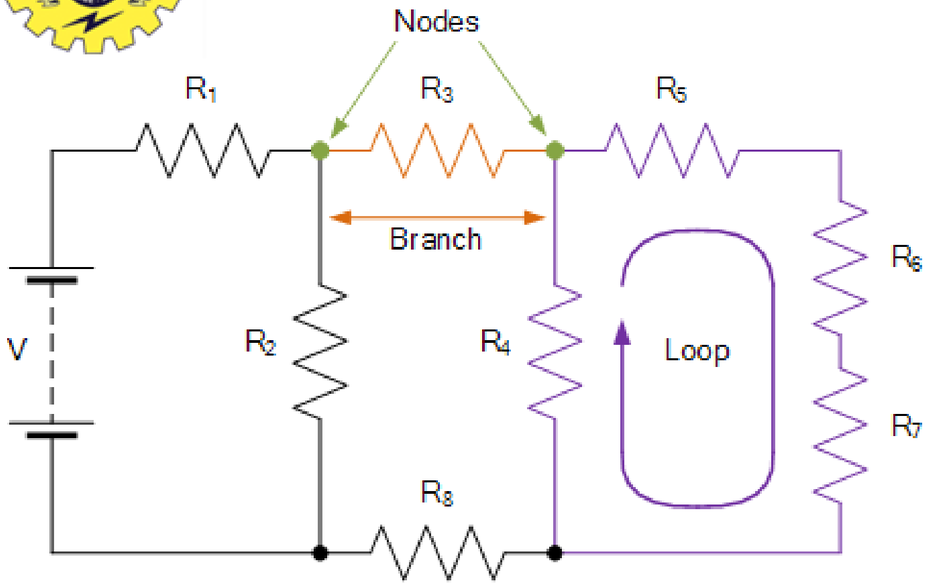
- Kirchhoff's Voltage Law or KVL, states that "in any closed loop network being driven by a voltage source, the total voltage around the loop is equal to the sum of all the voltage drops within the same loop" which is equal to zero. In other words the algebraic sum of all voltage sources and voltage drops within a closed loop must be equal to zero since the algebraic sum of the voltage drops equals the algebraic sum of the voltage sources.

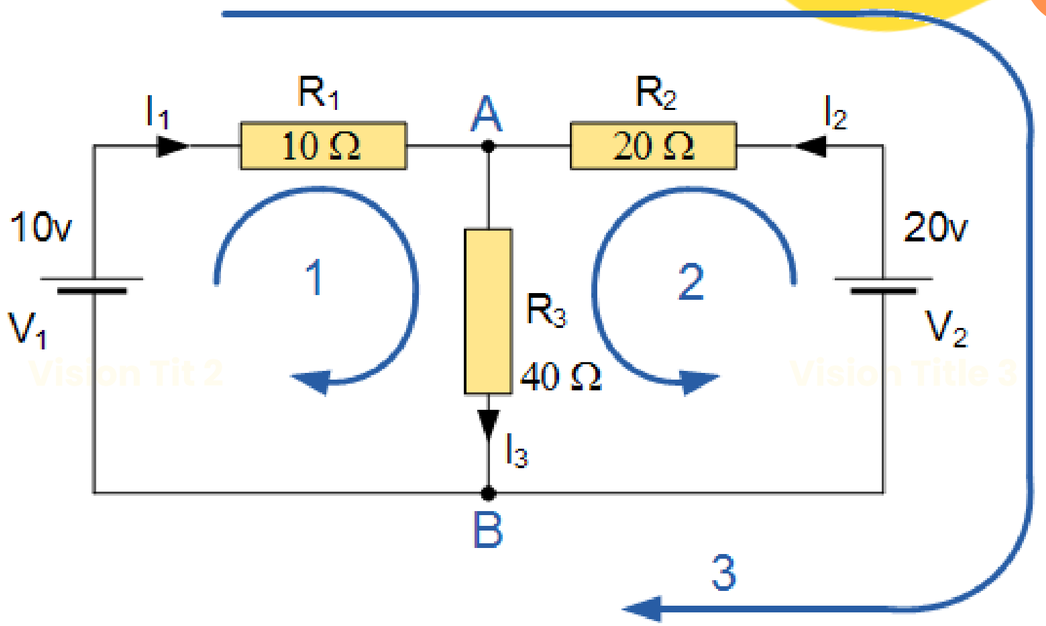
The sum of all the Voltage Drops around the loop is equal to Zero



$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$

A Typical DC Circuit





Using **Kirchhoff's Current Law**, **KCL** the equations are given as:

At node A : $I_1 + I_2 = I_3$

At node B : $I_3 = I_1 + I_2$

Using **Kirchhoff's Voltage Law, KVL** the equations are given as:

Loop 1 is given as : $10 = R1\ I_1 + R3\ I_3 = 10I_1 + 40I_3$

Loop 2 is given as : $20 = R2\ I_2 + R3\ I_3 = 20I_2 + 40I_3$

Loop 3 is given as : $10 - 20 = 10I_1 - 20I_2$