SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution
Coimbatore-35

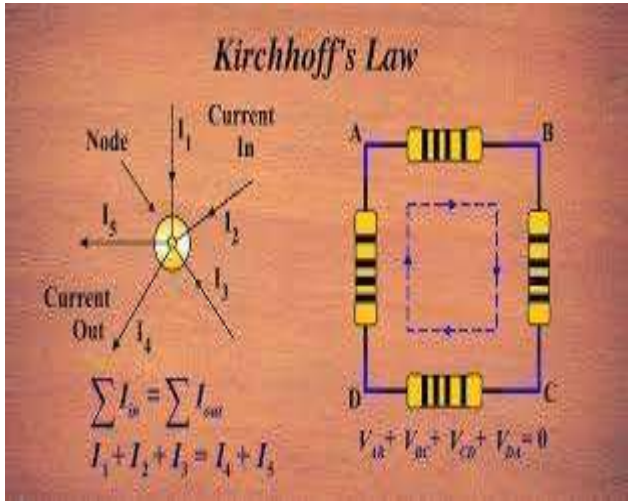
Department of Artificial Intelligence and Data Science

23EET103-Electric Circuits and Electron Devices

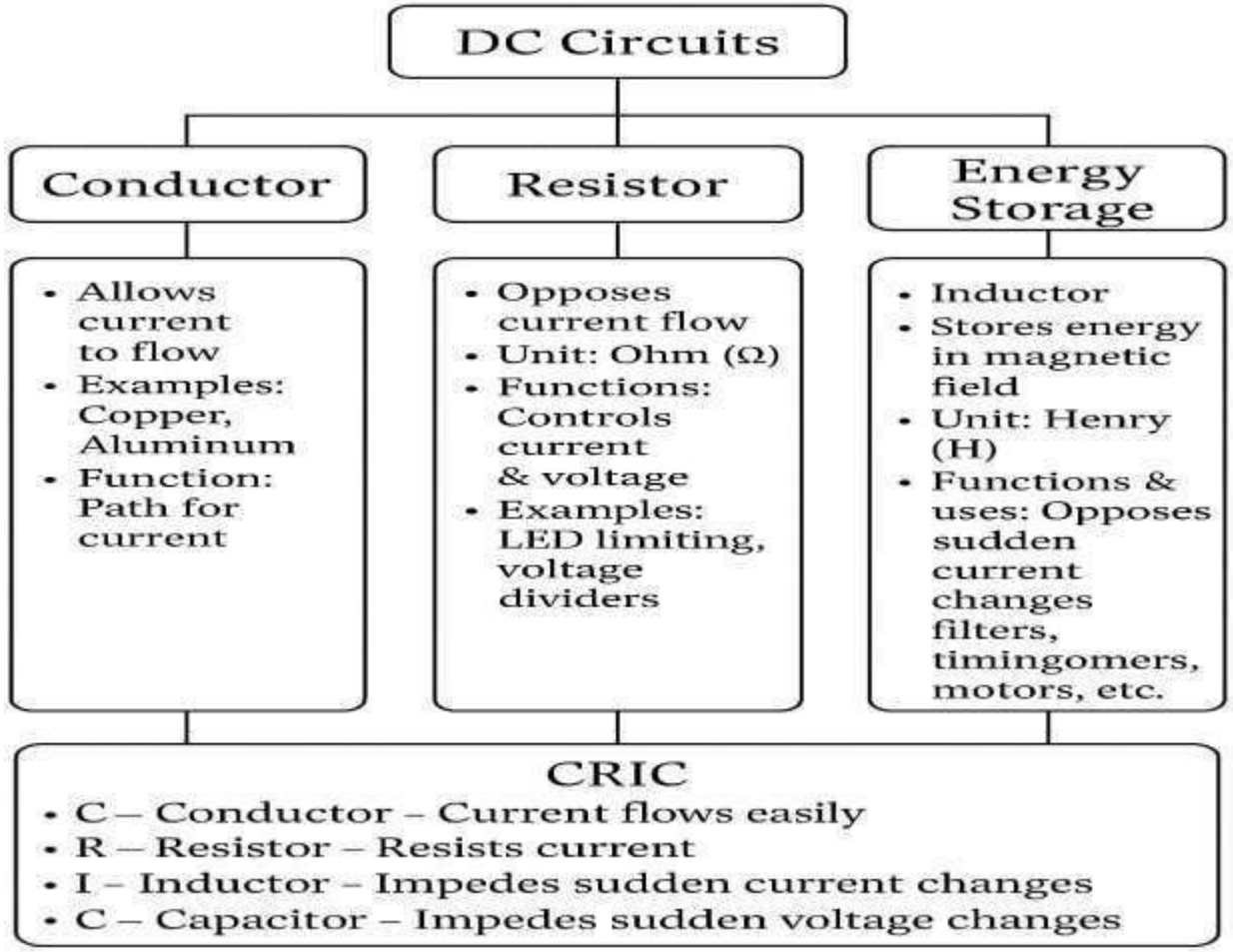
I B.Tech. AIDS / II SEMESTER

UNIT I : DC CIRCUITS

Topic 7 : Kirchhoff‘s law



Let's Recall !!


DC Circuits
Conductor
Resistor
Energy Storage
• Allows current to flow
• Examples: Copper, Aluminum
• Function: Path for current
• Opposes current flow
• Unit: Ohm (Ω)
• Functions: Controls current & voltage
• Examples: LED limiting, voltage dividers
• Inductor
• Stores energy in magnetic field
• Unit: Henry (H)
• Functions & uses: Opposes sudden current changes filters, timingomers, motors, etc.
CRIC
• C – Conductor – Current flows easily
• R – Resistor – Resists current
• I – Inductor – Impedes sudden current changes
• C – Capacitor – Impedes sudden voltage changes

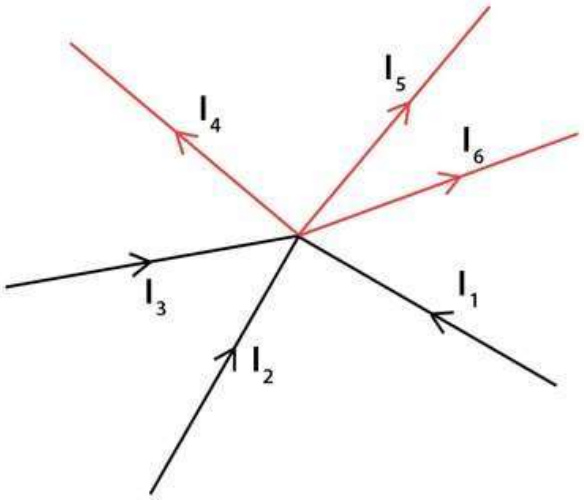
Topics for discussion

- Fundamentals and History
- Kirchhoff's Current Law (KCL)
- Kirchhoff's Voltage Law (KVL)
- Application in Circuit Analysis
- Real-World Examples and Advanced Concepts

Lets explore !!

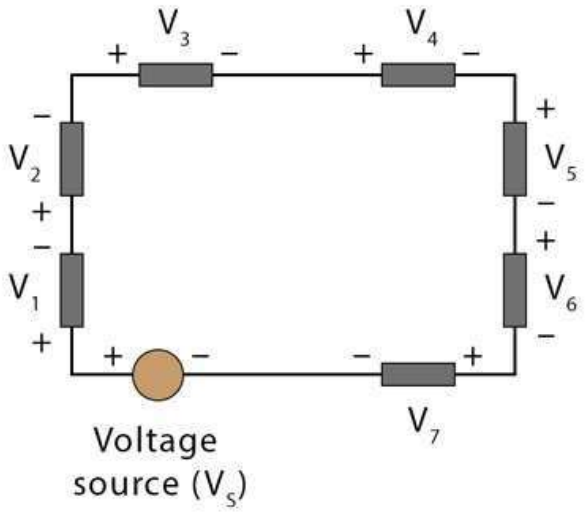
Kirchhoff's Law

Kirchhoff's Current Law



$$I_1 + I_2 + I_3 = I_4 + I_5 + I_6$$

Kirchhoff's Voltage Law



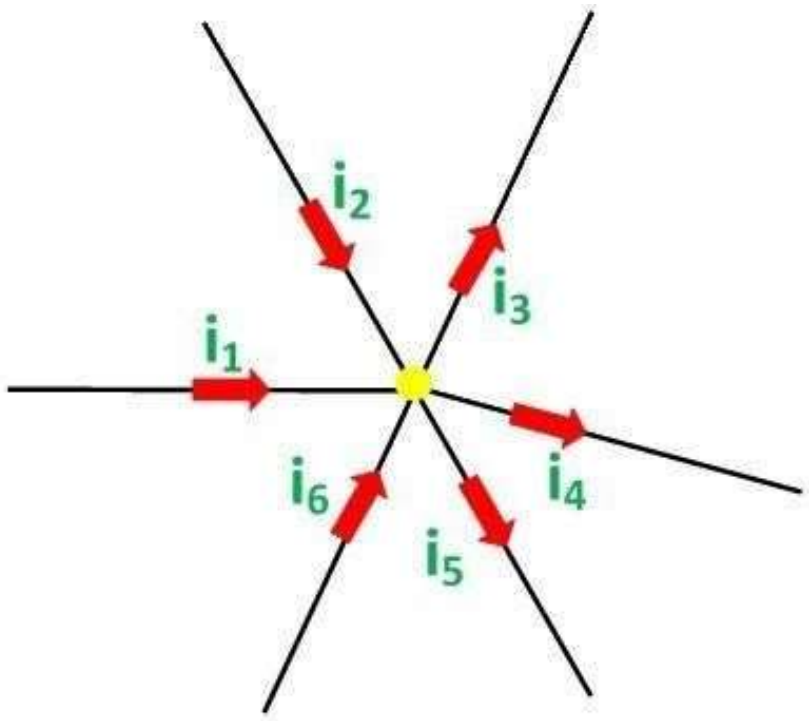
$$V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + V_7 - V_S = 0$$

ScienceFacts.net

Introduction to Electrical circuits: Basic components (resistors, voltage sources, currents).

- **History**: Gustav Kirchhoff (1845), based on conservation of charge and energy.
- **Why important?** Foundation for analyzing complex DC circuits beyond Ohm's Law.

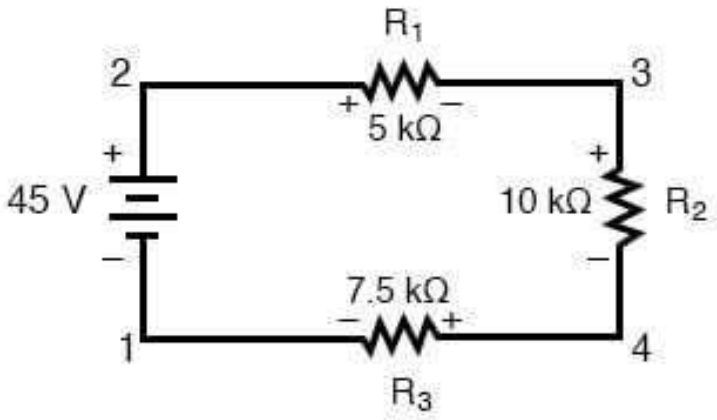
Kirchhoff's Current Law (KCL)

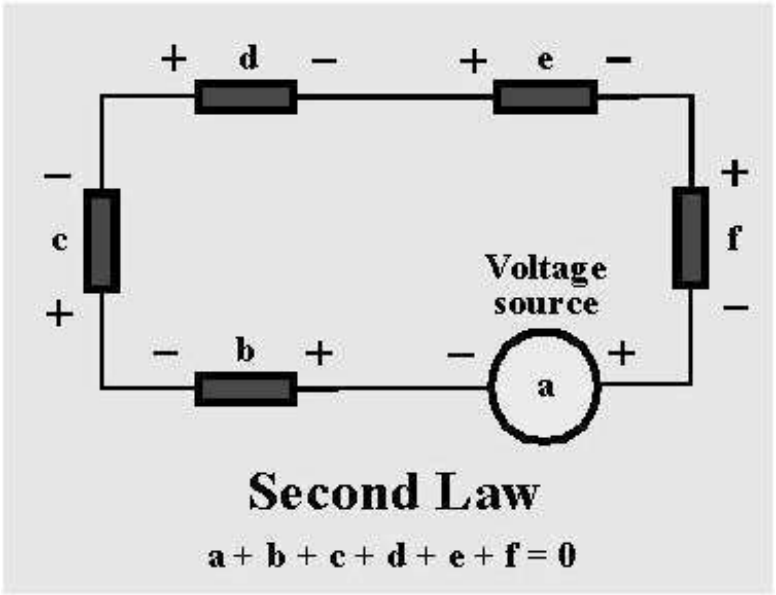


Statement: At any node (junction), the sum of currents entering equals the sum of currents leaving (∑I_in = ∑I_out).

- Based on conservation of charge.
- Equation: I1 + I2 = I3 + I4 (example).
- Simple example: Node with three branches.

Kirchhoff's Voltage Law (KVL)





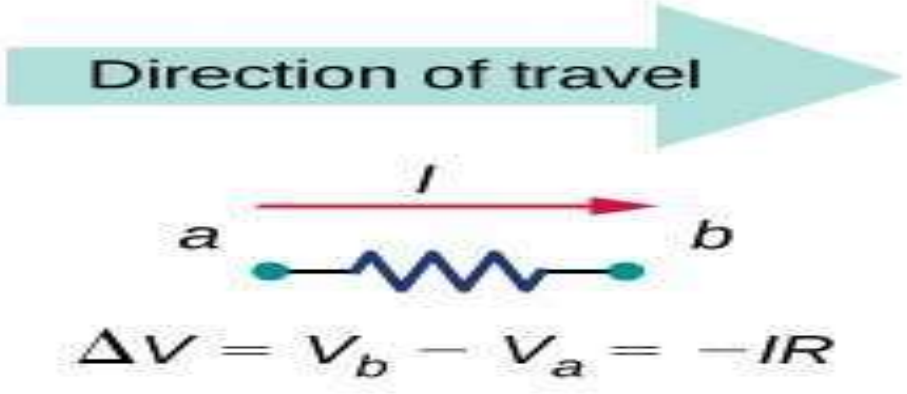
Statement: In any closed loop, the sum of voltage drops equals the sum of voltage rises (∑V = 0).

Based on conservation of energy.

Equation: V_source - V_R1 - V_R2 = 0 (example).

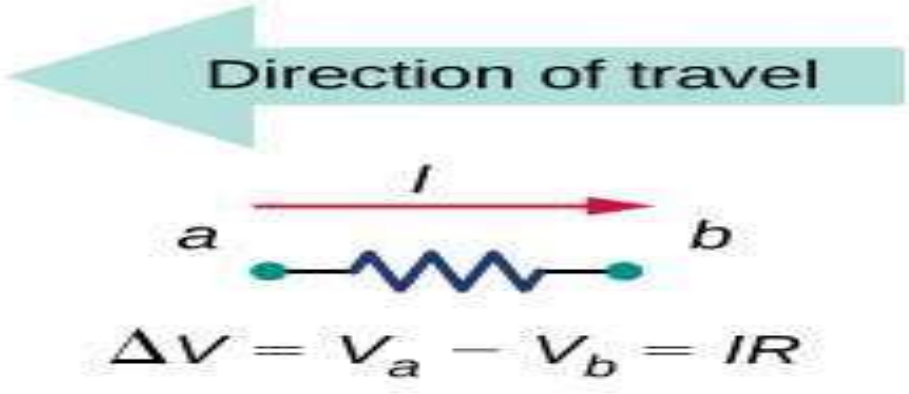
Simple example: Series circuit loop.

Loop- Rule



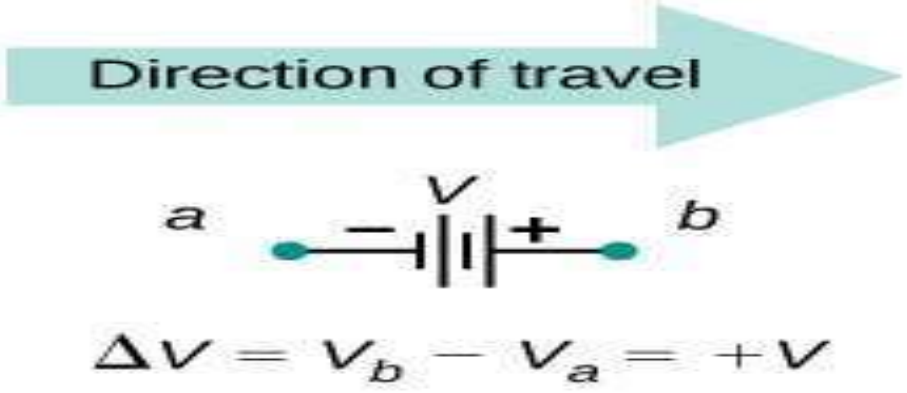
$$\Delta V = V_b - V_a = -IR$$

(a)



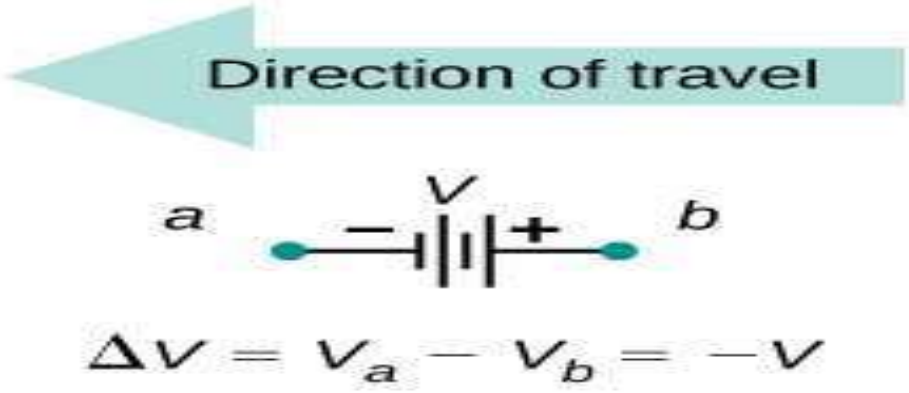
$$\Delta V = V_a - V_b = IR$$

(b)



$$\Delta V = V_b - V_a = +V$$

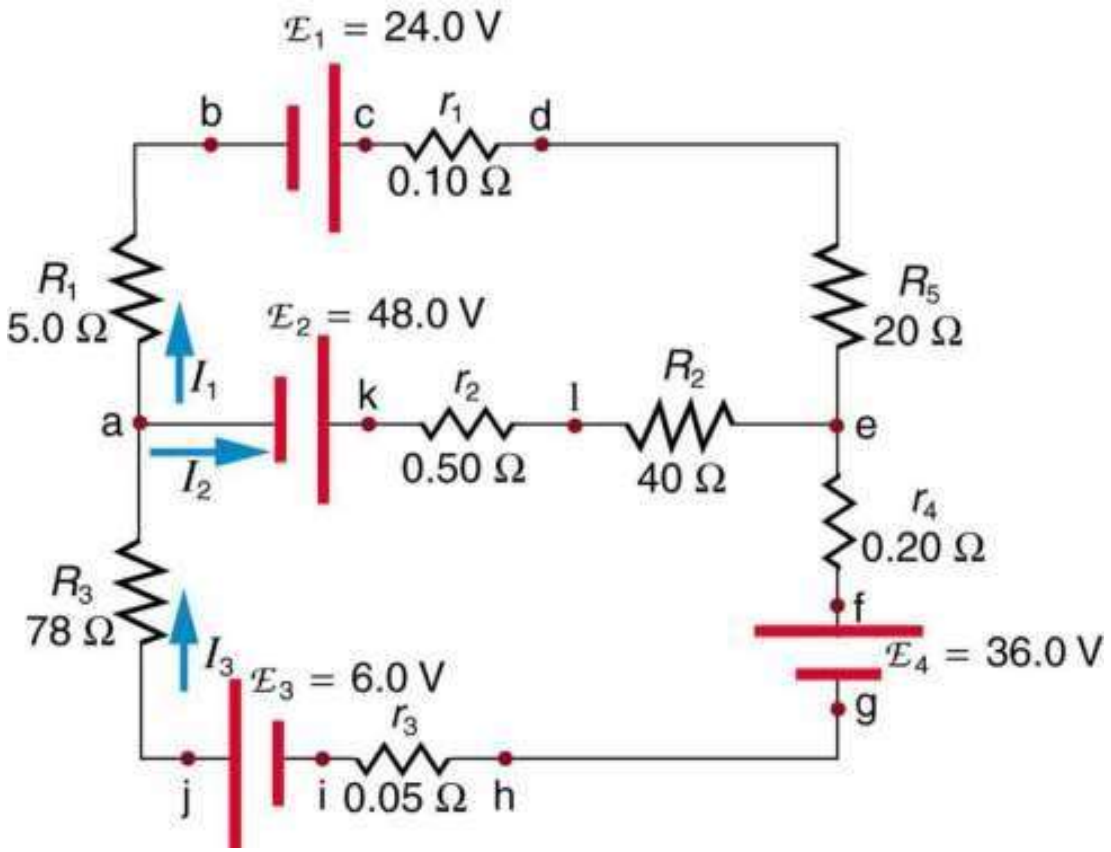
(c)



$$\Delta V = V_a - V_b = -V$$

(d)

Kirchhoff's Law



DT-Empathize

What are circuits?

Systems that power devices like phones or lights.

- **Kirchhoff's Laws (1845):** Rules to predict how electricity flows, like water in pipes.

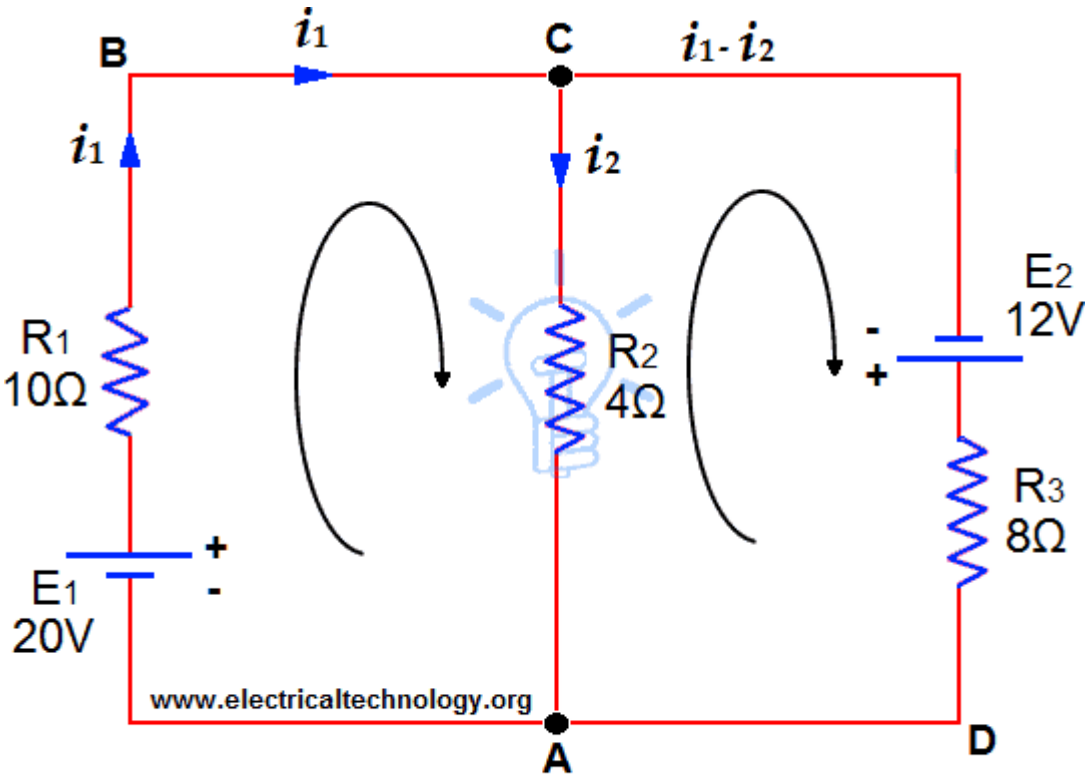
- **Empathetic Example:**

Imagine planning a family budget—money in equals money out, like current in a circuit.

- **Why it matters?**

  Helps design devices you use daily.(e.g., Chargers).

DC circuit components



DT-
Define

- Kirchhoff's laws are fundamental principles of physics used to analyze electrical circuits, and they have no connection to empathy.
- The user's query combines a physics concept with a psychological one, indicating a misunderstanding of the terms.

Application in Circuit Analysis

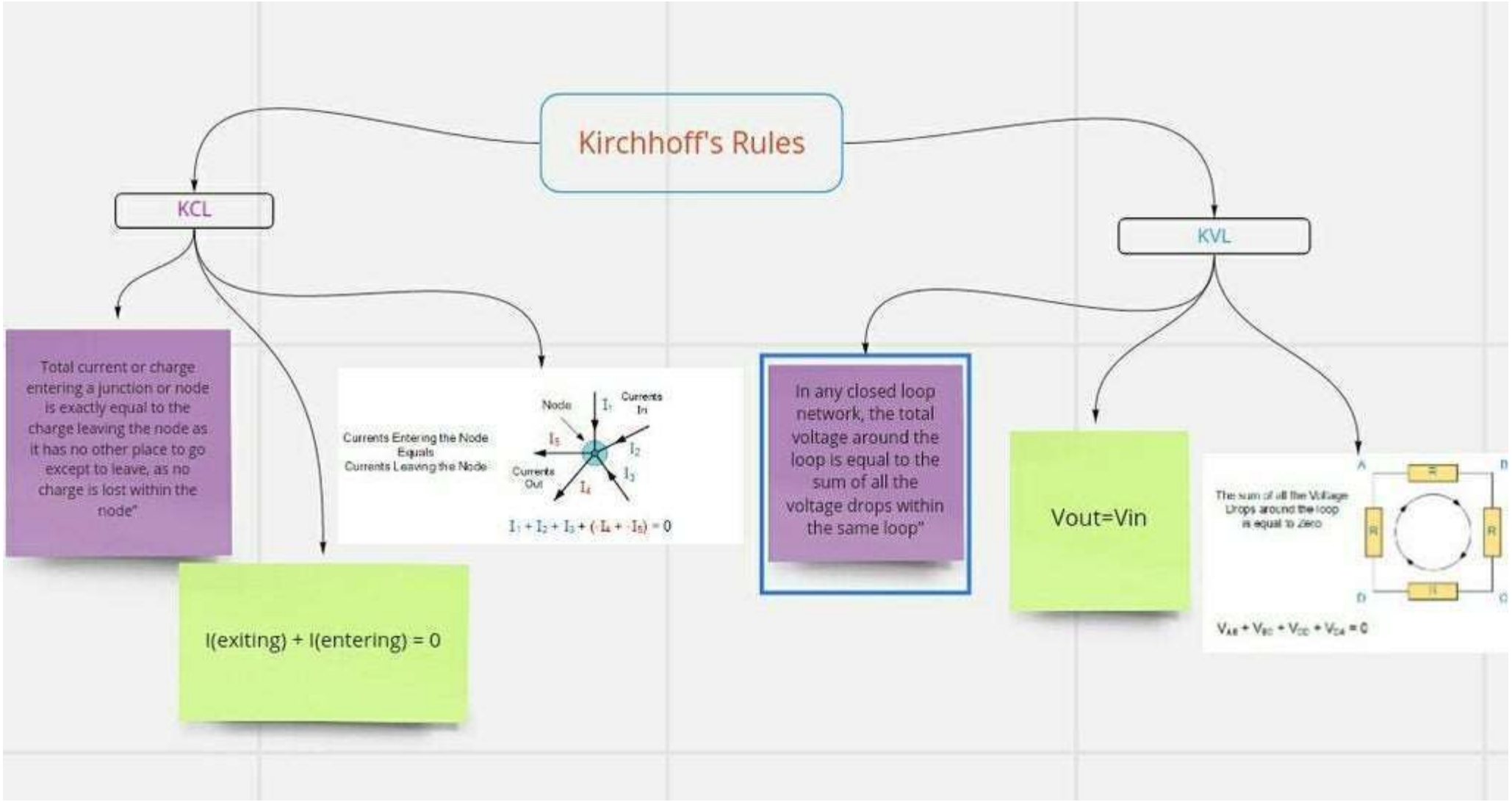
Applications: Electronics design (e.g., smartphones), power systems, mesh/nodal analysis.

Limitations: Assumes lumped elements; not for high-frequency or non-linear circuits.

Advanced: Superposition theorem integration, software simulation (e.g., SPICE).

Empathetic Example: Designing a home lighting system—use KCL to ensure current splits correctly for each bulb, KVL to balance voltage.

Let's summarize



ASSESSMENTS

1.At a node, currents entering are 4A and 6A. Current leaving is I.

☞ Find **I.**

Ans: Currents entering = 4A + 6A

I=10A

2.At a junction, 10A enters. Two currents leave: 3A and I.

☞ Find **I**

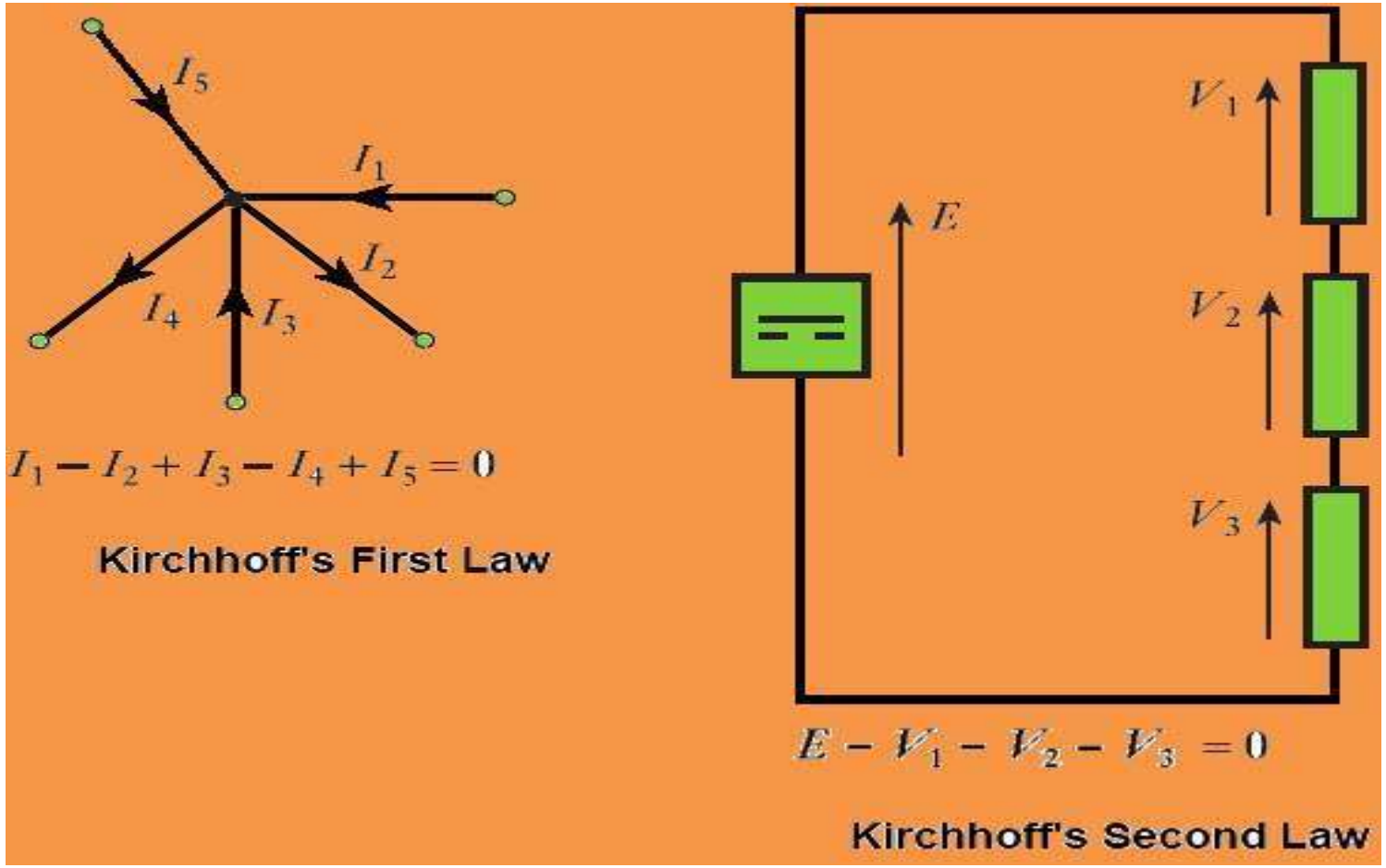
Ans: Incoming = 10A

Outgoing = 3A + I,10=3+I

I=7A

References

- https://courses.lumenlearning.com/suny-physics/chapter/21-3-kirchhoffs-rules/?utm_source=chatgpt.com
- https://www.khanacademy.org/science/ap-physics-2/x0e2f5a2c:electric-circuits/x0e2f5a2c:current-resistivity-ohms-law/a/ee-kirchhoffs-laws
- https://www.sciencedirect.com/topics/engineering/kirchhoff-law


I_5
I_1
I_2
I_4
I_3
$I_1 - I_2 + I_3 - I_4 + I_5 = 0$
Kirchhoff's First Law
V_1
E
V_2
V_3
$E - V_1 - V_2 - V_3 = 0$
Kirchhoff's Second Law

Thank you!