

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

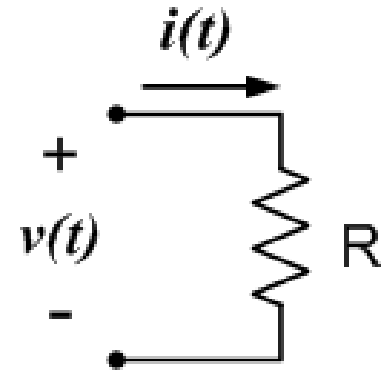
UNIT I : DC CIRCUITS

Topic : Kirchoff's Law

Review: Ohm's Law

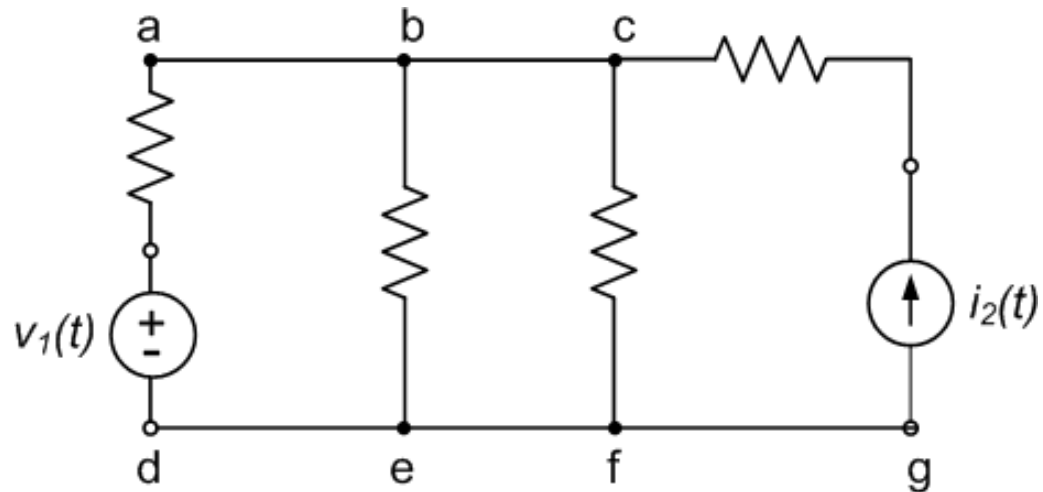
- **Ohm's Law**
- **Voltage-current characteristic of ideal resistor:**

$$v(t) = R \cdot i(t)$$



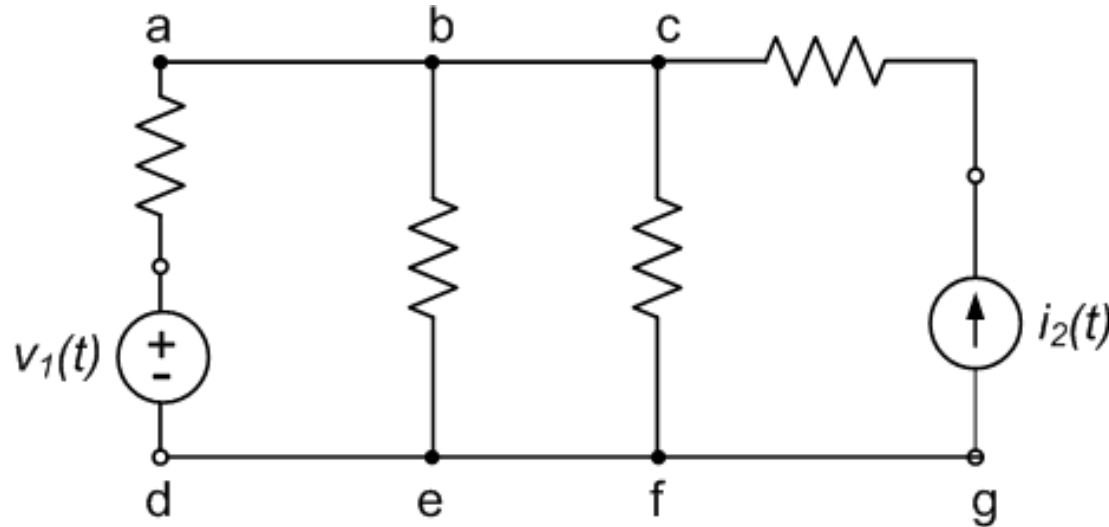
Basic Definition – Node

- A *Node* is a point of connection between two or more circuit elements
- Nodes can be “spread out” by perfect conductors



Basic Definition - Loop

- A *Loop* is any closed path through the circuit which encounters no node more than once

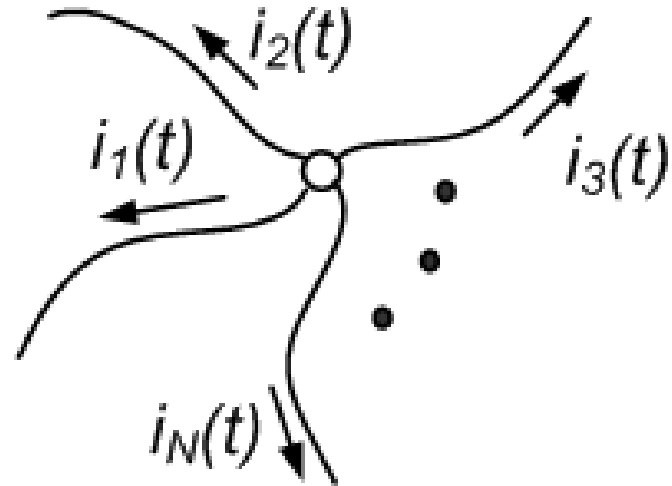


Kirchoff's Current Law (KCL)

- The algebraic sum of all currents entering (or leaving) a node is zero
- Equivalently: The sum of the currents entering a node equals the sum of the currents leaving a node

- Mathematically:
$$\sum_{k=1}^N i_k(t) = 0$$

- We can't accumulate charge at a node

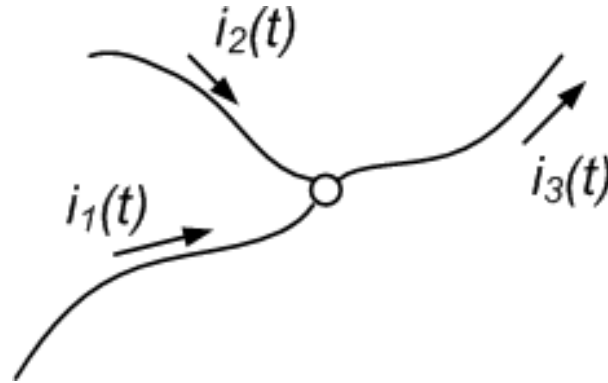


Kirchoff's Current Law – continued

- When applying KCL, the current directions (entering or leaving a node) are based on the assumed directions of the currents
- Also need to decide whether currents entering the node are positive or negative; this dictates the sign of the currents leaving the node
- As long all assumptions are consistent, the final result will reflect the actual current directions in the circuit

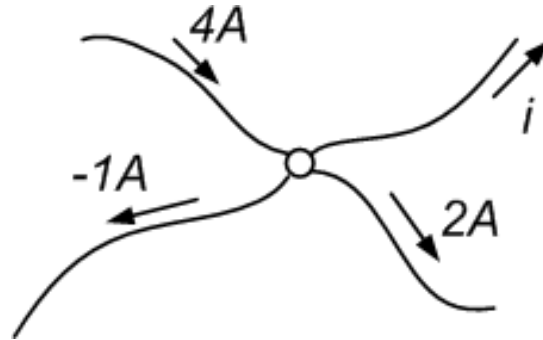
KCL - Example 1

- Write KCL at the node below:



KCL - Example 2

- Use KCL to determine the current i

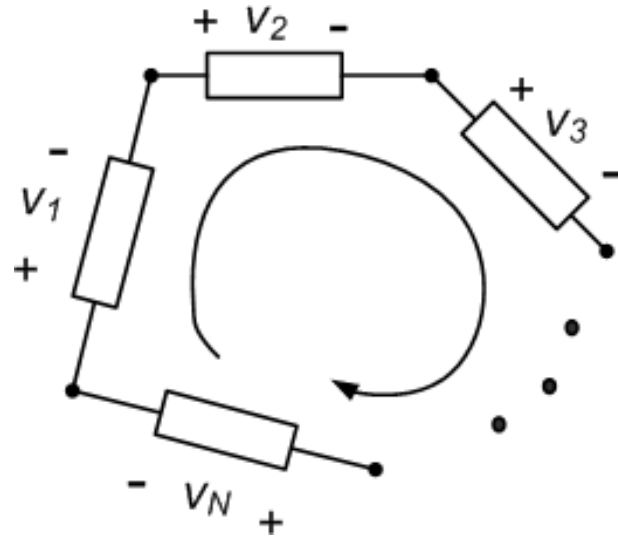


Kirchoff's Voltage Law (KVL)

- The algebraic sum of all voltage differences around any closed loop is zero
- Equivalently: The sum of the voltage rises around a closed loop is equal to the sum of the voltage drops around the loop

- Mathematically:
$$\sum_{k=1}^N v_k(t) = 0$$

- If we traverse a loop, we end up at the same voltage we started with

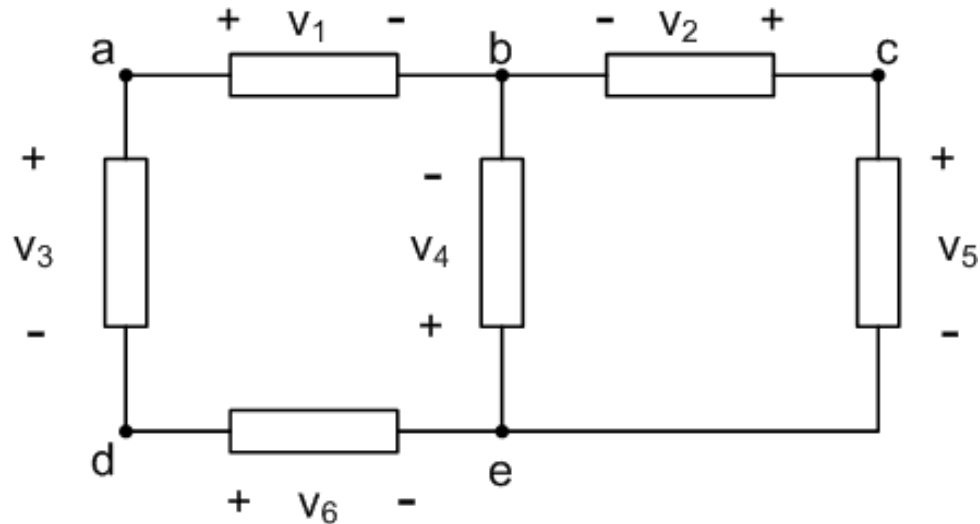


Kirchoff's Voltage Law – continued

- Voltage polarities are based on assumed polarities
 - If assumptions are consistent, the final results will reflect the actual polarities
- To ensure consistency, I recommend:
 - Indicate assumed polarities on circuit diagram
 - Indicate loop and direction we are traversing loop
 - Follow the loop and sum the voltage differences:
 - If encounter a “+” first, treat the difference as positive
 - If encounter a “-” first, treat the difference as negative

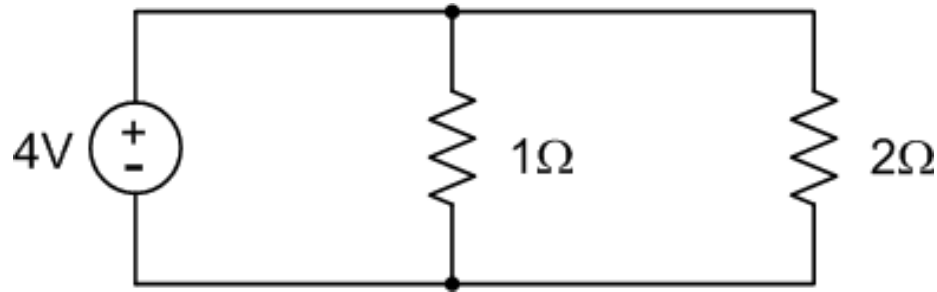
KVL - Example

- Apply KVL to the three loops in the circuit below. Use the provided assumed voltage polarities



Circuit analysis – Example

- For the circuit below, determine:
 - (a) The current through the 2Ω resistor
 - (b) The current through the 1Ω resistor



References

- https://phet.colorado.edu/sims/html/ohms-law/latest/ohms-law_en.html
- <https://www.allaboutcircuits.com/textbook/direct-current/chpt-2/voltage-current-resistance-relate/>
- <https://www.fluke.com/en-us/learn/blog/electrical/what-is-ohms-law>

