Class Concepts

- Understanding circuit topology
  - Identifying nodes, branches & loops in circuits

- Open & Short circuits
  - Implied resistance for the branch
  - V across & I through for the branch

- Kirchhoff → Conservation laws
  - Current law, KCL (conservation of charge)
  - Voltage law, KVL (conservation of energy)

Recap: Electricity Concepts

- Define in words and with an equation/expression

  - Current
    - Symbol and unit:

  - Resistance
    - Symbol and unit:

  - Voltage
    - Symbol and unit:

  - Power
    - Symbol and unit:
    - How is power related to energy?
Defining a Circuit

- What elements can be in a circuit?
  - Energy source – independent and dependent
  - Energy dissipating element
  - Energy storage elements
  - A “load”

- Give examples of each element

New Concepts: Open & Short Circuits

**Tasks:**
- Draw an example of each type of branch
- Relate each to Ohm’s Law \( V = IR \)
- What are \( V \) and \( I \) in each example?
  - \( 0? \quad <0? \quad >0? \quad \infty? \)

Open & Short Circuits

Find \( V \) & \( I \) for resistors \( R_1 \) & \( R_2 \)

* Open & Short Circuits *

- If there is no current, can there be a voltage drop?
  - Examples?

- If there is no voltage drop, can there be current?
  - Examples?

- Power Sources
  - What is the difference between a current source and a voltage source?
New Concepts & Laws

- Node, Branch & Loop
- Series resistors
  - Series elements; series branches
  - Shared: nodes? current? voltage?
- Parallel resistors
  - Parallel elements; parallel branches
  - Shared: nodes? current? voltage?
- KVL: Kirchhoff’s voltage law
- KCL: Kirchhoff’s current law

Discuss: Nodes & Branches

- A branch represents a single element such as a voltage source or a resistor.
- A node is the point of connection between two or more branches.

Identify nodes, branches & loops

- How many of each and where are they?
- Which elements are in parallel and which are in series?
Nodes, Branches, Loops, Series & Parallel

Kirchhoff’s Current and Voltage Laws: KVL & KCL

Kirchhoff’s Current Law, KCL
• Current flowing in = current flowing out.
• Principle of conservation of ____________?
• The math expression is:
Kirchhoff’s Current Law
- Find $i_1$, $i_2$, and $i_3$
  - Label nodes
  - Write KCL eqn’s
  - Solve
    - We will use Ohm’s law when there are resistors in the circuit diagram

Kirchhoff’s Voltage Law, KVL
For EVERY loop: $\Sigma V_{\text{loop}} = 0$

Kirchhoff’s Current Law
- 12 mA
- 8 mA
- 9 mA
- $i_1$
- $i_2$
- $i_3$

Kirchhoff’s Voltage Law, KVL
- Draw and label an electrical circuit that is consistent with the graph shown below.
Kirchhoff’s Voltage Law, KVL

- The conservation of ________
- Combine Ohm’s law with KVL to solve for ________?

![Circuit Diagram]

New Terminology

- Node
- Branch
- Loop
- Series
- Parallel

Kirchhoff’s Voltage Law

- Apply KVL
  - Label voltages
  - Write KVL eqn’s
  - We will solve later with mesh analysis

![Circuit Diagram]
New Analysis Tools

• Ohm’s law
• KVL: Kirchhoff’s voltage law
• KCL: Kirchhoff’s current law
• Current divider
• Voltage divider
• Equivalent resistance

Summary

• New Concepts
  • Kirchhoff’s current and voltage laws
  • Series and parallel combinations
  • Open and short circuits
  • Nodes, branches and loops

• Labs
  • Pre-lab due before lab
  • One per team for ‘design your own lab’ days
  • Lab memo completed with partner, one memo per team

Office & Tutor Hours

• Office Hours
  • Monday: 10:15 – 11:45
  • Tuesday: 1:30 – 2:30

• Master Tutor
  • Sunday – Thursday evenings there will always be 3 or so master tutors in the Playground
  • [https://www.smith.edu/qlc/tutoring.html?colEGR=open#PanelEGR](https://www.smith.edu/qlc/tutoring.html?colEGR=open#PanelEGR)

• Tani Somolu point person for EGR 220

Questions?