Introduction to Electrical Engineering (ECE 302H) – Fundamentals of Electricity

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1 Charge

- Proton $= 1e$
- Electron $= -1e$
- **Coulomb** $= 6.24 * 10^{18}e$

2 Electricity

- Imbalance of Charge: **Static Electricity**
- Imbalance in Flow of Charge: **Current**

> **Remark 2.1.** Dr. Hanson drew two examples of charge flowing. In the first example, there are 2 positive charges moving right and 2 negative charges moving right. In the second example, there are 2 positive charges moving right, **but** 2 negative charges moving left.
>
> The first example experiences no current while the second example does.

> **Remark 2.2.** I want to clarify here that conventional current follows the direction that the positive charges move. Dr. Hanson's second example would therefore imply that the conventional current moves towards the right.

3 Current

Definition 3.1. **Current** is definied as a coulomb per second also known as an amp or ampere and is represented with i.

insert circuit diagram

4 Potential (Energy)

Definition 4.1. **Electric potential** is defined as a joule per coulomb also known as a volt. Because of this, electric potential is often refered to as voltage.

5 Power

> **Remark 5.1.** Recall that power in mechanics comes from a joule per second. If we multiply current and electric potential (voltage), coulombs cancel out and we end up with joules per second or watts
>
> $$\frac{J}{C} \times \frac{C}{s} = \frac{J}{s} = W$$

6 Circuits

Remark 6.1. Dr. Hanson breaks down "solving" a circuit into two steps:

1. Laws of Physics
2. Solving Systems of Equations

6.1 Relevant Laws of Physics

- Conservation of Charge
$$\sum_{\text{into node region}} i = 0$$
also known as Kirchoff's Current Law **(KCL)**
- Conservation of Energy
$$\sum_{\text{loop}} V = 0$$
also known as Kirchoff's Voltage Law **(KVL)**
- Component i-V Relationship
  - Voltage Source
$$V(i) = V_{\text{value}}$$
    Remark 6.2. Note that just because current is not in the equation, it is not zero
  - Resistor
$$V(i) = Ri$$
    where R is resistance measured in $\frac{V}{A} = \Omega$.

insert example of circuit with 3V source and 1.5ohm resistor

6.2 Important Circuit Terminology

- Node - Wire
- Loop - Think of it as anywhere you can draw a loop
- Series - Two components experience same current by KCL
- Parallel - Two components experience same voltage by KVL

6.3 Passive Sign Convention

Definition 6.3. an electrical engineering standard where the current is assumed to flow from the positive (+) terminal of a component to the negative (-) terminal, and the power absorbed by the component is considered positive (a sink of power)

Remark 6.4. Basically just label current going from the positive to negative terminal.

6.4 Equivalent Circuits

Definition 6.5. If two circuits have the same i-v relationship, they are **equivalent**