Simulated Circuits Lab – Week 7: James, Kyle

1. Resistors in series
    a. Build a circuit with a 10V voltage source and two resistors in series
    b. Define nodes on either side of the voltage source and in between the resistors
    c. Examine the voltage values at each node and the current for the system
    d. Add a third resistor and an additional node and make note of how this changes the voltage at each node and the current in the system.
        - **Although the voltage drop across all the resistors is still 10V, adding a third resistor makes the intermediate voltages different and lowers the overall current everywhere**

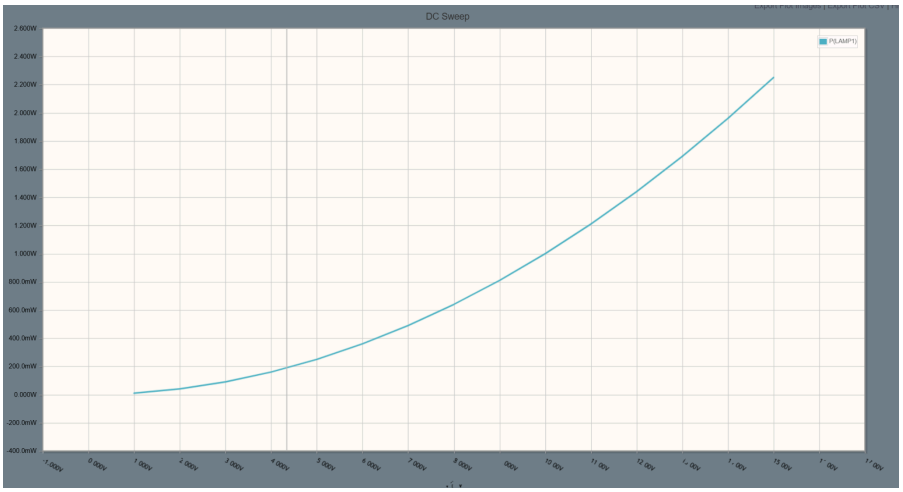
    https://www.circuitlab.com/circuit/z9phpedwk8k6/resistors-in-series/
2. Resistors in parallel
    a. Build a circuit with a 10V voltage source and two resistors in parallel
    b. Define nodes on either side of the voltage source and each resistor
    c. Examine the voltage values at each node and the current across the voltage source and each resistor
    d. Add a third resistor in parallel and additional nodes. Make note of how this changes the voltage at each node and the current across each resistor.
        - **The voltage across each resistor is the same in parallel, but the current increases, which makes sense since you can think about it as a the water having more options (with less resistance) to flow down**

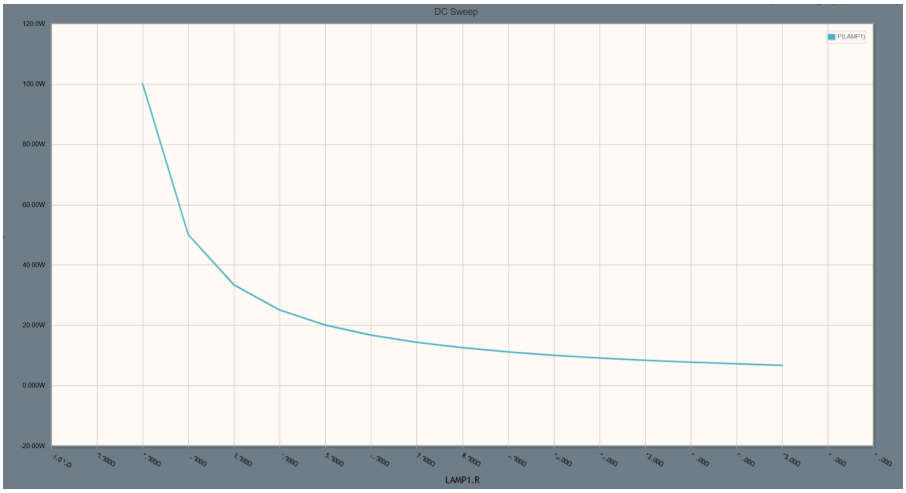
    https://www.circuitlab.com/circuit/k96895r5kf42/resistors-in-parallel/
3. Resistors in series and parallel
    a. Build a circuit with a 10V voltage source with two resistors in parallel and a third resistor in series – the third resistor is in series with each parallel resistor in a single loop.
    b. Define nodes on either side of the voltage source and across each of the resistors
    c. Examine the voltage value at each node and the current across the voltage source and each resistor. Make note of how this compares to either the case of resistors only in parallel or only in series.
        - **It is lower than just in parallel and higher than only in series**

    https://www.circuitlab.com/circuit/53m6b8wswf68/resistors-in-parallel-and-series/
4. Powering light bulbs
    a. Build a circuit with a 10V voltage source with a single 100Ohm lightbulb connected. What will the power output be for this lightbulb?
        - **P = V^2 / R**
        - **P = 1 J/s**

    b. Use the simulation DC solver to evaluate the lightbulb power and check your answer.
        - **Did evaluate to 1 W**

    c. Use the DC sweep simulation tool to examine how the lightbulb power varies with the voltage of the battery (voltage source) and how it varies with the internal resistance of the lightbulb.

- 

- **^ Changing Voltage**
- 

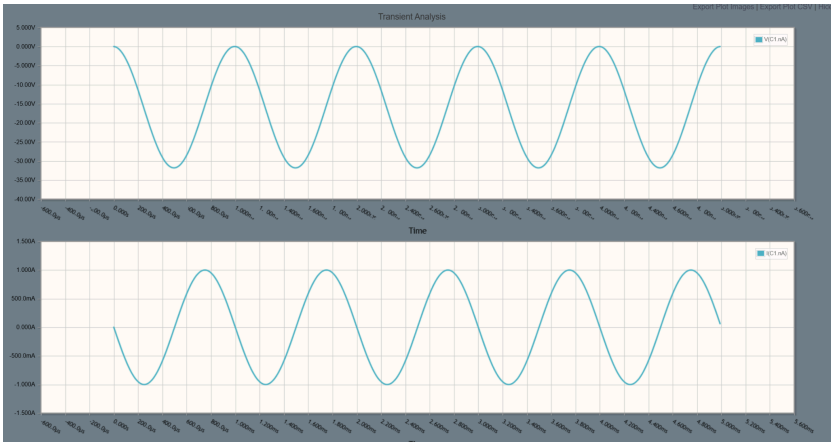
- **^ Changing Internal Resistance**
- **https://www.circuitlab.com/circuit/3kj7k8e5yfd7/powering-light-bulbs/**

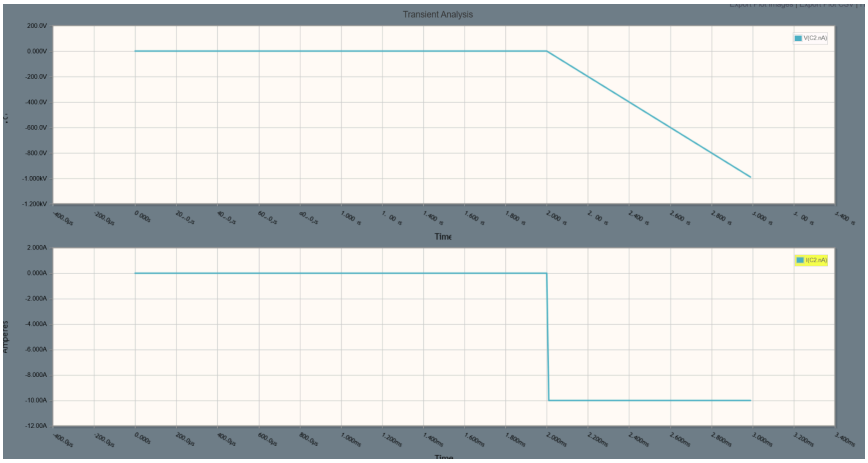
5. Capacitor circuit

a. Build a circuit with a 10uF capacitor connected to a varying 1kHz current source (try both sine and step
sources).

b. Use the time sweep simulation tool to examine how the voltage and current in the system varies over time. Try a few values for the capacitor.

- **Sine:**

- 

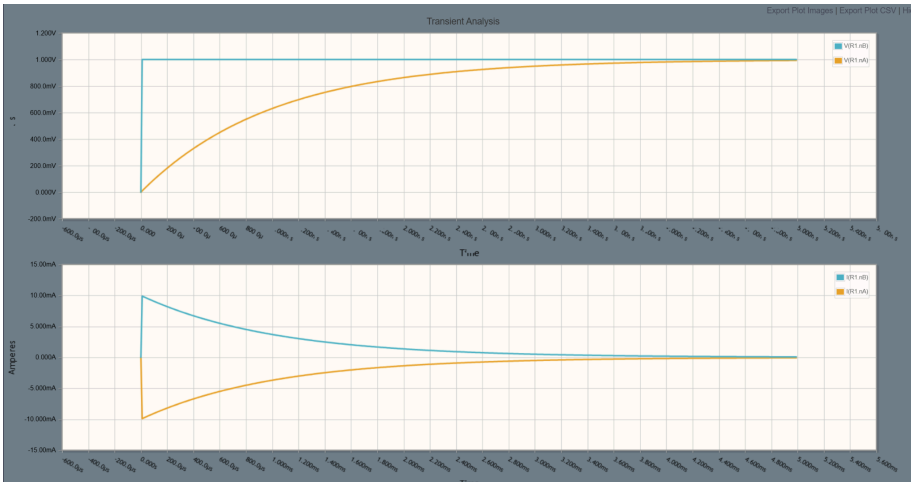
- **Voltage Drop across the capacitor is at a max when current is 0**
- **Step:**
- 

- **When the Current switches on, the voltage drop begins to “slowly” (this is a 3 ms interval) also increase**
- **https://www.circuitlab.com/circuit/mz2bvxn8wb3d/capacitor-circuit/**

6. RC circuit

a. Build a simple RC circuit with a step function voltage supply, a 100 Ohm resistor and 10uF capacitor. Add voltage in and out nodes on either side of the resistor.

b. Use the time domain simulator to examine how the voltage and current change over time.

- 

c. Explore how the time dependence of the system changes as you vary the resistance and capacitance in the system.

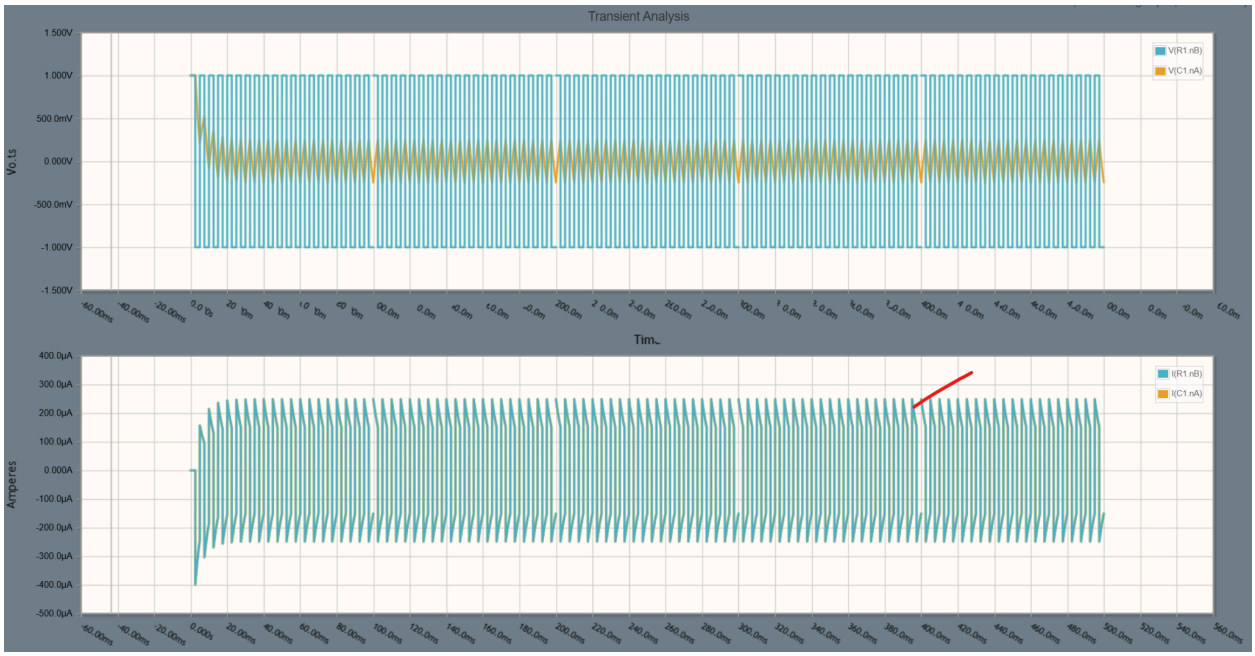
- **As Resistance increases, the amount of time necessary for the RC circuit to reach its limit, so does varying capacitance.**

https://www.circuitlab.com/circuit/p477ad852e67/rc-circuit/

7. RC filter

a. Build a circuit with an oscillating square wave (this is a parameter you can set) voltage supply, initially with a 100 Hz frequency. Include a 1kO resistor and a 1uF capacitor. Add nodes to examine the input and output voltage.

b. Use the time domain simulator to examine how changes to the resistance (and/or capacitance) effects the output voltage. Try out difference input voltage frequencies.



While the voltage of the circuit at both nodes periodically alternates between 1 and -1, the capacitor keeps the current at a steady amplitude with minimal impact from the changing voltage. As the resistor limits the voltage coming into the

capacitor, the capacitor passes the average frequency. We observe a suppression of the voltage after the capacitor
https://www.circuitlab.com/circuit/9tjn66v35eas/rc-filter/