ECE 30
Day 12 Notes

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Agenda

- Review Quiz 2
- RC circuits
- Touchscreens

Quiz 2 Review

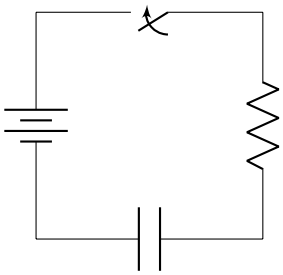
Notes on answers I think I got incorrect.

- 3 point flexure is about brittle materials not breaking
- I think I got this right, but capacitors in parallel are independent.
- Close reading, should have noticed the path is from B to A, and that the path goes with the field which means negative work happens
- Remain repelled but the distance will decrease (Not sure if I got this wrong, I was a little confused about the quiz wording.)

I'm a little annoyed but whatever. Also the professor goes over like a ton of the incorrect answers but not in a helpful way just like he feels he has to rexplain this to us over and over again.

RC circuits

An RC circuit is a circuit with both resistors and capacitors in it.



As the capacitor charges the current and voltage accross the resistor drops.

Based on the loop rule:

$$V - iR - v_c(t) = 0$$

This means that:

$$V - v_c(t) = iR$$
$$\frac{V - v_c(t)}{R} = i(t)$$

This means, as the charge increases in the capacitor, the current drops, until the capacitor matches the voltage of the battery and the current is zero.

This also means the voltage across the resistor will settle at zero.

This also means that initially when the capacitor has zero charge, the circuit will act as if the capacitor didn't exist.

This leads the rule of thumb that initially, capacitors act like wires and don't affect the current flow. And that when fully charged capacitors do not allow for current to flow and can be removed when thinking about current and voltage without altering the circuit.

In addition:

$$v_c(t) = \frac{q(t)}{C}$$

$$V - \frac{dq_c}{dt}R - \frac{q_c}{C} = 0$$

$$\frac{cV - q_c}{RC} = \frac{dq_c}{dt}$$

$$\frac{dt}{RC} = \frac{1}{CV - q}dq$$

$$\int_0^t \frac{dt}{RC} = \int_0^{q(t)} \frac{1}{CV - q}dq$$

$$\frac{t}{RC} = -ln(\frac{cv - q}{cv})$$

$$q(t) = CV(1 - e^{\frac{-t}{RC}})$$

This implies:

$$Q_{max} = CV$$

and:

$$i(t) = \frac{dq}{dt} = \frac{CVe^{\frac{-t}{RC}}}{RC}$$

$$i(t) = \frac{V}{R}e^{\frac{-t}{RC}}$$

This means the maximum current is $\frac{V}{R}$ which looks like Ohm's law. However it exponentially decays to zero as the capacitor charges.

Touchscreen

Grid of conductive line, one set sensing the other driving lines. At each intersection they form a capacitor.

The driving lines are energized one by one and each sensing line is checked.

When you touch the screen the ions in your blood are positively charged. Your finger creates a tiny parallel capacitor which changes the rate the capacitor charges and discharges. This is detectable and allows for calculating the point of contact.

This increases the capacitance of the screen which is detectable.