Course intro and circuits intro

Kjartan Halvorsen

2020-02-12

1 Course intro

1.1 Who am I

1.2 What the course is about

- Lab, so hands on work. Both analysis, implementation and experimentation. Simulation included.
- Circuits. Props: breadboard, multimeter, power supply, function generator, oscilloscope
  - Basic, but interesting electrical circuits. Dynamical properties.
  - Learn to use multimeter, power supply, function generator, oscilloscope
- Pneumatic systems. Props: tank, cylinders, valves
  - Tank system, PID control
  - Pneumatic cylinders, valves
- PLC
  - Used in industry to control processes.

1.3 Study guide

- Hand out
- Go through.
  - Emphasize objective
  - Go through plan

1.4 Groups

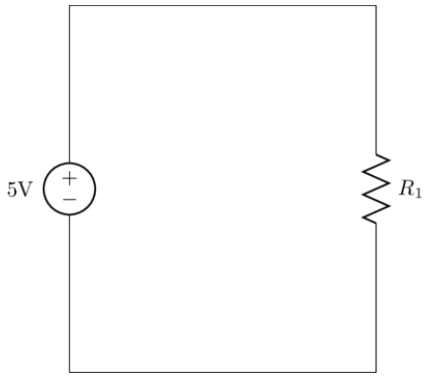
- Form four groups

2 Circuit intro

2.1 Get the material

2.2 Present the lab instructions

2.3 Circuit and physical implementation



Draw breadboard with resistor. Connect!

Describe the ideal voltage source: Will provide any current that the circuit may demand, at a perfectly constant voltage u.

2.4 Important relationsships

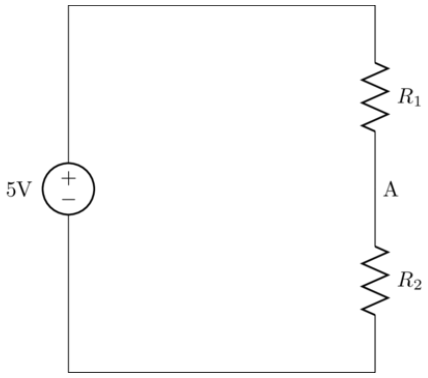
2.4.1 Ohm's law

$u = Ri$

2.4.2 Kirchoff's current law

2.4.3 Kirchoff's voltage law

2.5 Series connection



In the equivalent circuit with a single resistor R_3, then clearly $u_3 = u$. And for the original circuit $u = u_1 + u_2$. The same current i flows through all the elements, so from Ohm's law $u_k = R_k i_k$, we get $u_3 = u_1 + u_2$ and

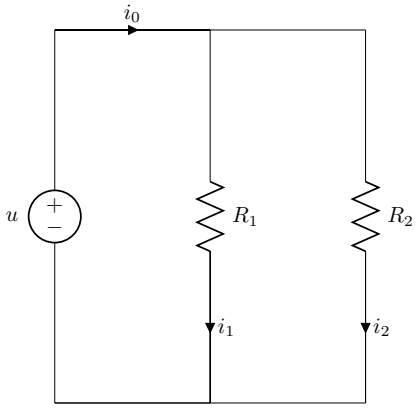
$$R_3 i = R_1 i + R_2 i = (R_1 + R_2) i$$

$$R_3 = R_1 + R_2$$

This means that $i = \frac{u}{R_1 + R_2}$. So what is the voltage over R_2?

$$u_2 = R_2 i = u \frac{R_2}{R_1 + R_2}.$$

2.6 Parallel connection



In an equivalent circuit with only one resistor R_3, we must have $u_3 = u = R_3 i_0$, which implies $i_0 = \frac{u}{R_3}$. For the two resistors in the circuit, we have $u_1 = u = R_1 i_1$ and $u_2 = u = R_1 i_1$, which gives

$$i_1 = \frac{u}{R_1} \qquad \text{and} \qquad i_2 = \frac{u}{R_2}$$

From Kirchoff's current law $i_0 = i_1 + i_2$, so we get

$$\frac{u}{R_3} = \frac{u}{R_1} + \frac{u}{R_2} = u\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

hence

$$\frac{1}{R_3} = \frac{1}{R_1} + \frac{1}{R_2}$$

The reciprocal $\frac{1}{R}$ of a resistance is called *admittance*.

2.7 Safety instructions

2.7.1 Connect everything first, then turn on the power supply

2.7.2 Use low voltage, 5V