Inbyggd elektronik 2018-04-17 #8

Up to now, everything has been static (DC)
No time dependence.

Module 3: C, L, V(t), i(t)

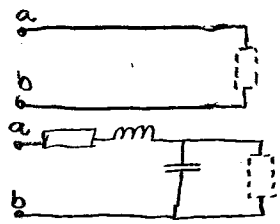
- Capacitance and inductance are geometrical effects
- They introduce/cause time delays in circuits.

Capacitance $Q = C \cdot V$ — Any separation of charge will generate an electric field between the charges.
[F] Farad ⇒ The charges are at different electrical potential.

Inductance $\Phi_B = L \cdot I$ — Φ_B is the magnetic flux. Any moving charges (i.e current) will set up a magnetic field.
[H] Henry

- Faradays induction law states that a time varying magnetic field induces a voltage, (and thus a current), in a conductor.

Capacitance and inductance effects are "everywhere" but can often be negliable. For example two wires



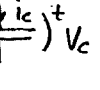
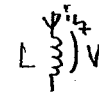
can be modeled as

A Capaticor is a device designed to have a large capacitance
- Two parallell plates seperated by a thin insulator has a high capacitance $C = \frac{\varepsilon A}{d}$. ε [F/m]

An Inductor is a device designed to have a large inductance
- A conducting wire formed like a coil has a high inductance

$L = \mu_0 n^2 A L$ μ_0 [H/m]
n = turns/unit length

Two new linear circuit elements
Capacitor and Inductor

Resistor	Capacitor	Inductor
		
$V_R = RI_R$	$i_C = C\frac{dV_C}{dt}$	$V_L = L\frac{di_L}{dt}$
	V_C is continous since $i_C \neq \infty$	i_L is continous since $V_L \neq \infty$
Converts electrical energy to heat/light	Store/release electrical energy (from/to circuit) in/from an electric field between the two metal plates.	Store/release electrical energy (from/to circuit) in/from a magnetic field in the coil.

NOTE
$f(x+y) = f(x) + f(y)$ additivity
$f(ax) = af(x)$ homogenity
This is called a linear map or that the function is linear.

Resistor	Capacitor	Inductor
No energy is stored	$E = C\frac{V_c^2}{2}$	$E = L\frac{i_c^2}{2}$
	$P = \frac{dE}{dt} = C V_c \frac{dV_c}{dt} = i_c V_c$	$P = \frac{dE}{dt} = L i_c \cdot \frac{di_c}{dt} = i_c V_c$