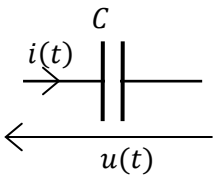
Survival Kit
Transient Modes

The following is the bare minimum in Electronics needed to solve exercises on transient regimes. The rest is math! Fundamental laws will be your best friends, and it is often useful to reduce to a simple RC or RL circuit using Thévenin/Norton equivalents.

1. Capacitor

✓ Current/Voltage Relationship:

$$i(t) = C.\frac{du}{dt}$$



✓ Continuity :

The voltage at the terminals of a capacitor cannot change abruptly.

We say there is continuity of voltage at the terminals of a capacitor.

✓ Régime continu

In a steady DC regime, currents and voltages are constant. However, if $u(t) = cste$, then, $\frac{du(t)}{dt} = 0$. The current $i(t)$ in the capacitor is therefore zero.

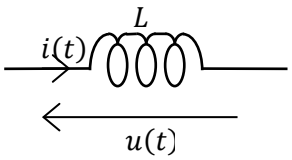
In a steady DC state, a capacitor behaves like an open switch.

Recall that the voltage at the terminals of an open switch is generally not zero.

2. Inductor (Coil)

✓ Current/Voltage Relationship:

$$u(t) = L.\frac{di}{dt}$$



✓ Continuity :

The current flowing through an inductor cannot change abruptly.

We say there is continuity of current in an inductor.

AS Dujardin

✓ Régime continu

In a steady DC regime, currents and voltages are constant. However, if $i(t) = cste$, then, $\frac{di(t)}{dt} = 0$. The voltage $u(t)$ at the terminals of an inductor is therefore zero.
In a steady DC state, an inductor behaves like a wire.

Continuity properties allow us to know what happens during a change of situation in a circuit ($t = 0^+$ which often corresponds to the opening or closing of a switch, for example).

The behaviors of components in a steady DC state allow us to know what is obtained when the steady state is reached ($t \to \infty$).

The circuits studied in this chapter are governed by differential equations, meaning that the studied signals $s(t)$ (currents or voltages) are the solutions of differential equations. They can be put in the form:

$$\frac{ds(t)}{dt} + \frac{1}{\tau}.s(t) = A$$

where :

- τ = time constant of the circuit. At $t = 5\tau$, the steady state is considered to be reached.
- A is a constant, which can be zero.

The solutions are then of the form:

$$s(t) = \alpha.e^{-\frac{t}{\tau}} + \beta$$

We find α by using the initial conditions and β, which is also called the particular solution, corresponds to the value of the signal in steady state.