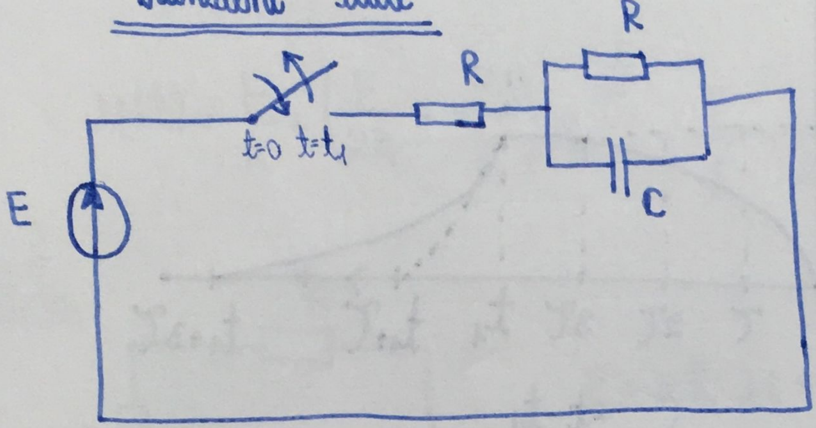
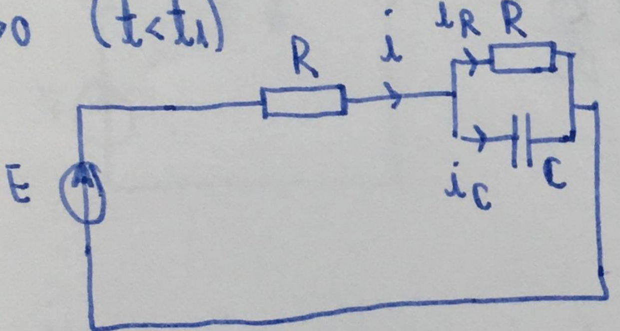
CURS BAZE 17 — 21.12.2016

14: empty pages: time varying state of el. circuits (I eq. of el. circuits under time varying cond)
15: 20.12.2016
16: Operational calculus of linear dynamic circuits (La Place method)
II the direct solution mth of linear dynamic circ.
13: Non sinusoidal
12: Comput

Transient State



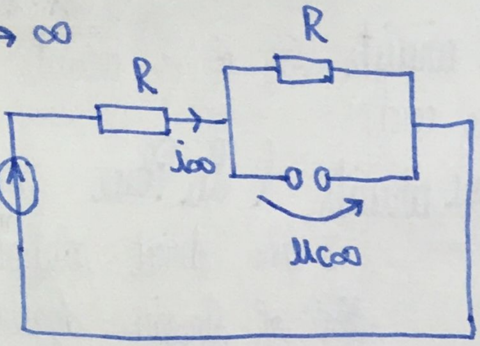
$t>0 \quad (t<t_1)$



$$\begin{cases} i = i_R + i_C \\ E = R \cdot i + u_c \\ 0 = u_R - u_c \end{cases}$$

$$u_c(t) = u_{c\infty} + (\underbrace{u_{c0+}}_{u_{c0-}=0} - u_{c\infty}) \cdot e^{-\frac{t-t_0}{\tau}}$$

$t \to \infty$



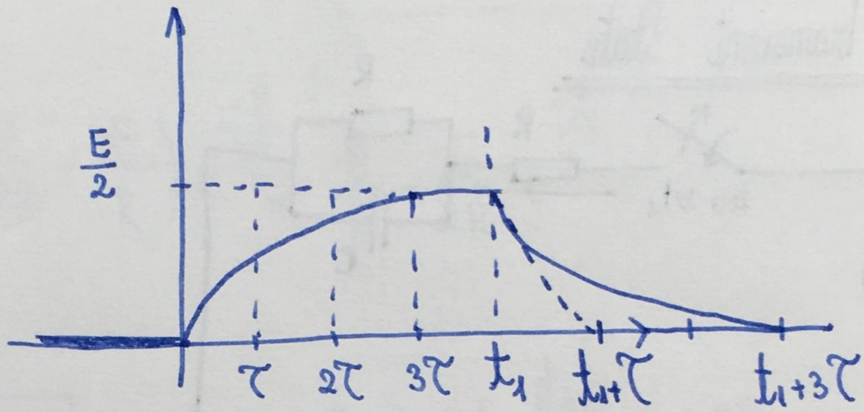
$$i_\infty = \frac{E}{2R}$$

$$u_{C\infty} = R \cdot i_\infty = R \cdot \frac{E}{2R} = \frac{E}{2}$$

$\tau = RC$

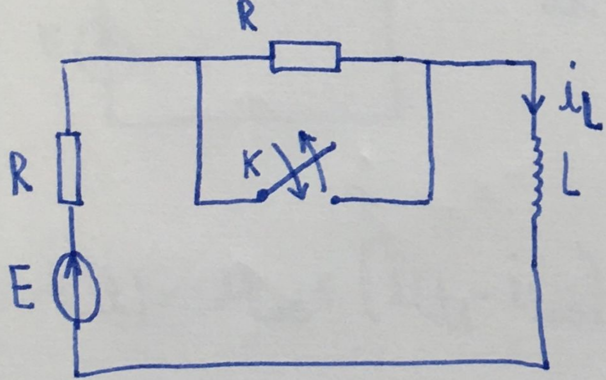
$\updownarrow$

t_1

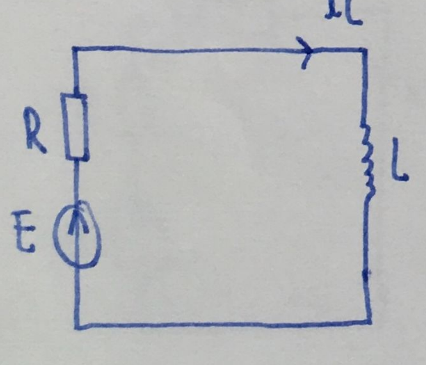


II $u_C(t) = u_{C\infty} + (u_{C\,t_1+} - u_{C\infty})\, e^{\frac{-t-t_1}{\tau}}$

(2)



$t>0,\ t<1$



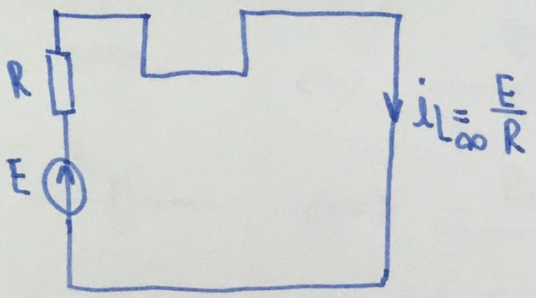
$$E = R \cdot i_L + L \frac{di_L}{dt} \quad \Big| : R$$

$$\frac{E}{R} = i_L + \frac{L}{R} \frac{di_L}{dt}$$

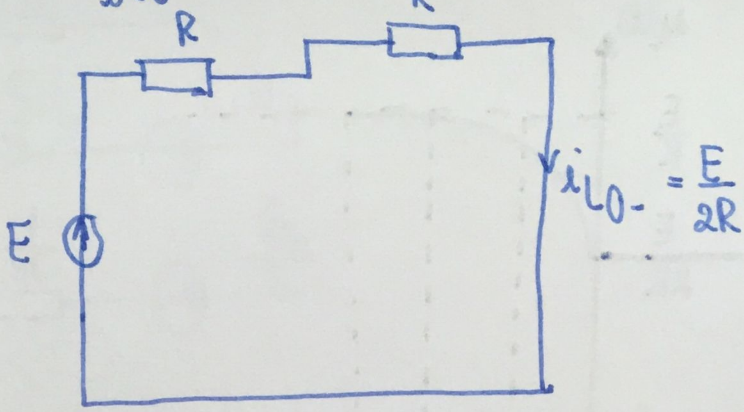
$\frac{L}{R} \to \tau$

$$i_L(t) = i_{L\infty} + (i_{L0+} - i_{L\infty}) \cdot e^{\frac{-t-t_0}{\tau}}$$

$t>0,\ t\to\infty$

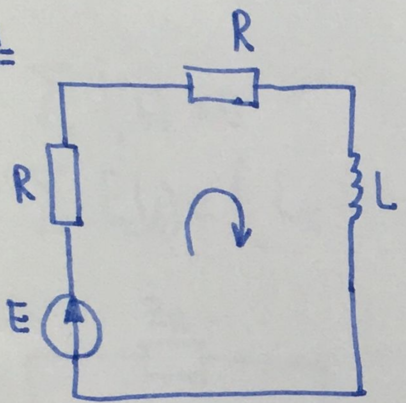


$t<0$



$$i_L(t) = \frac{E}{R} + \left(\frac{E}{2R} - \frac{E}{R}\right) e^{\frac{-t}{\tau}} = \frac{E}{R} - \frac{E}{2R} e^{\frac{-t}{\tau}}$$

$\underline{t>t_1}$



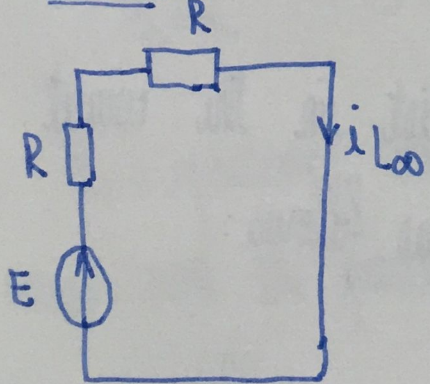
$$E = 2R \cdot i_L + L \frac{di_L}{dt} \quad \Big| : 2R$$

$$\frac{E}{2R} = i_L + \frac{L}{2R} \frac{di_L}{dt}$$

$\frac{L}{2R} \to \tau_1$

$$i_L(t) = i_{L\infty} + (i_{Lt_1} - i_{L\infty}) e^{\frac{-t-t_1}{\tau_1}}$$

$\underline{t>t_1},\ \underline{t\to\infty}$



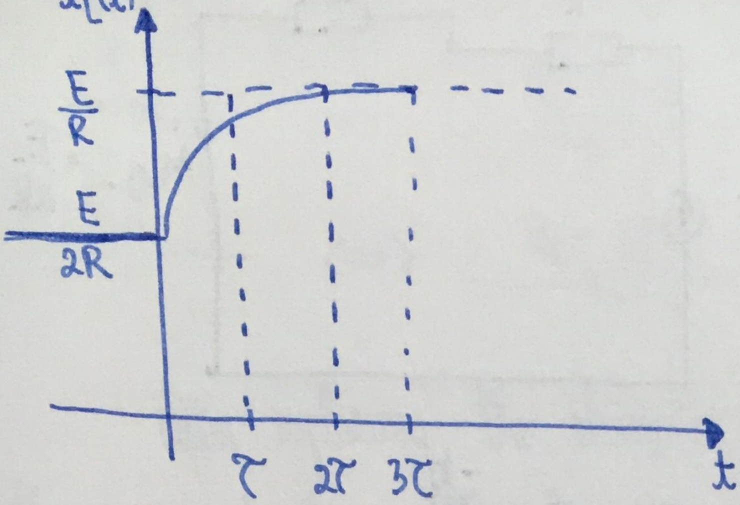
$i_{L\infty} = \frac{E}{2R}$

$\underline{t<t_1}$ $\quad i_{Lt_1+} = i_{Lt_1-}$

a). $t_1 < 3\tau$: $i_{Lt_1-} = \frac{E}{R} - \frac{E}{2R} e^{\frac{-t_1}{\tau}}$

b). $t_1 > 3\tau$

$i_{Lt_1-} = \frac{E}{R}$ ($i_{L\infty}$!)



$$i_L(t) = \frac{E}{2R}\left(\begin{cases} \frac{E}{R} - \frac{E}{2R}e^{-\frac{t}{\tau}} \\ \frac{E}{R} \end{cases} - \frac{E}{2R}\right) e^{-\frac{t-t_1}{\tau_1}}$$

Laplace method

$$\underline{f(t)} \xrightarrow{\mathcal{L}} F(s)$$

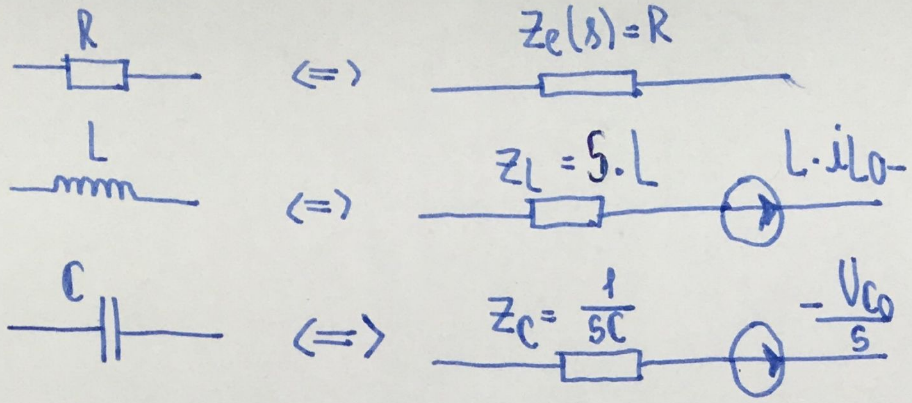
time domain equation

It is generally applied for 2^{nd} order circuits under transient state (the presence of 2 diff. reactive elements in the circuit).

Both inductor and capacitor exist in the circuit.

The circuit will be transformed as follows:

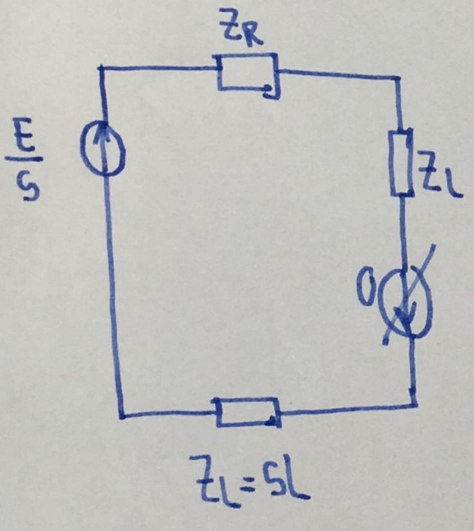
$E \Longleftrightarrow \frac{E}{S}$, S = Laplace variable

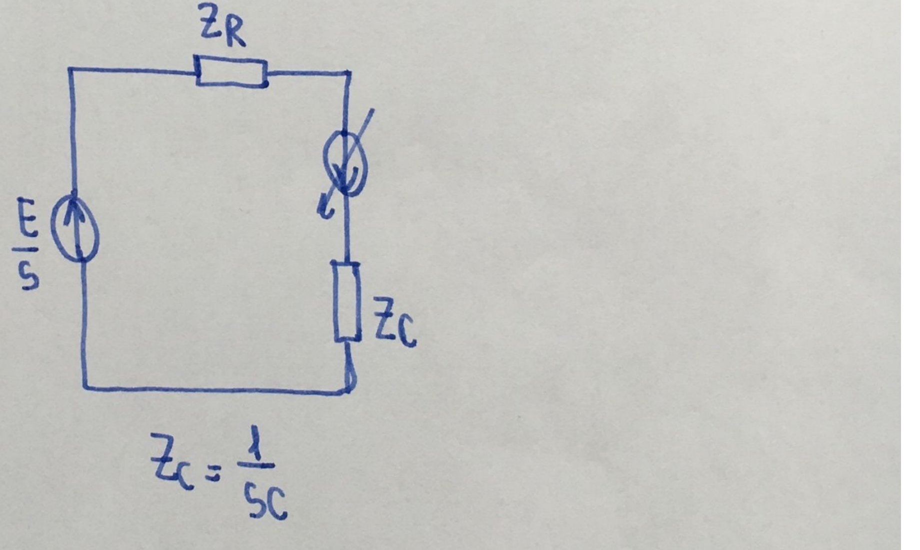


After replacing the elements of the initial circuit by the correspondent operational comp., the equations become linear.

$$i(t) \longrightarrow \dot{I}(s)$$

$$\begin{cases} \sum \dot{I}_k(s) = 0 \\ \sum E_k(s) \pm \left(L_k i_{L0-_k} + \dfrac{u_{C0-k}}{s} \right) = \sum\limits_k Z_{k(s)} \cdot \dot{I}_{k(s)} \end{cases}$$





The operational impedances follow the same formula for the series and the parallel connections as the resistors