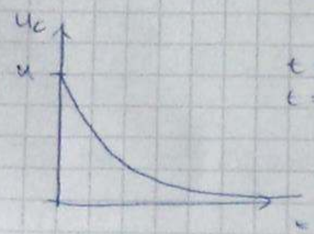
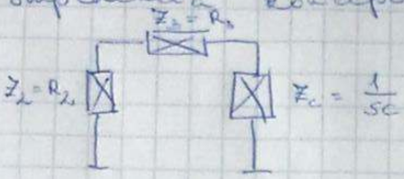
$) = u + u\left(e^{-\frac{1}{R_2C}\cdot t} - 1\right) = u + u\cdot e^{-\frac{1}{R_2C}t} - u = u\cdot e^{-\frac{1}{R_2C}t}$



$t = 0 \quad u$
$t = \infty \quad 0$

impedancia koncepció



$\frac{1}{sC} + R_C = 0$

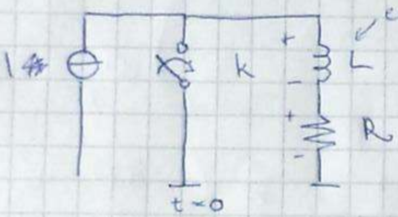
$\frac{1}{C} + s\cdot R_C = 0$

$s = -\frac{1}{C\cdot R_C}$

Impedancia koncepció!

$$\boxed{\begin{aligned} Z_R &= R \\ Z_C &= \frac{1}{sC} \\ Z_L &= sL \end{aligned}}$$

impedancia: látszólagos ellenállás.

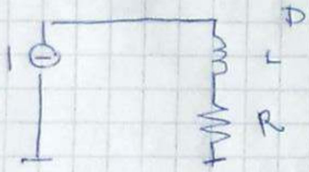


energiatároló elem

$i(0) = 1$

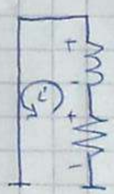
$i_L = ?$

elektromos mágneses teret indukál, ami ellentétes feszültséget generál



DC-be rövidzár

Kikapcsolva az kapcsolót



$u_L = L\cdot\frac{di}{dt}$

$-u_L - u_R = 0$

$+L\cdot\frac{di}{dt} + R\cdot i = 0$

$i = A\cdot e^{st}$

$\frac{di}{dt} = s\cdot A\cdot e^{st}$

$L\cdot s\cdot A\cdot e^{st} + R\cdot A\cdot e^{st} = 0$

$A\cdot e^{st}(Ls + R) = 0$

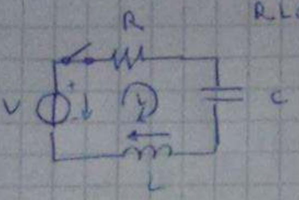
$Ls + R = 0$

$s = -\frac{R}{L}$

$i = A\cdot e^{-\frac{R}{L}\cdot t}$

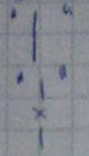
$i(0) = 1 = A\cdot 1$

$i = 1\cdot e^{-\frac{R}{L}\cdot t} = i_L$



RLC kör

$t = 0$ $\quad$ $t = \infty$



$u_L - u = 0$

a tekercs a végtelenben rövidzár
a kapacitás — " — szakadás

$$\begin{cases} i(0) = 0 \\ u_L(0) = u \end{cases} \longrightarrow u_L(0) = L \cdot \frac{d_i(0)}{dt}$$

$$R \cdot i + \frac{1}{C}\int i\, dt + L \cdot \frac{di}{dt} - u = 0 \qquad (\;)'$$

$$R \cdot \frac{di}{dt} + \frac{1}{C} \cdot i + L \cdot \frac{d^2 i}{dt} = 0$$

$$i = A \cdot e^{st} \qquad R s A \cdot e^{st} + \frac{1}{C} \cdot A \cdot e^{st} + L \cdot s^2 A \cdot e^{st}$$

$$\frac{di}{dt} = s \cdot A \cdot e^{st}$$

$$\frac{d^2 i}{dt} = s^2 \cdot A \cdot e^{st}$$

$$A \cdot e^{st} \left(\cancel{Rs} + L \cdot s^2 + R \cdot s + \frac{1}{C} \right) = 0 \quad / \cdot C$$

$$\cancel{A \cdot e^{st}} \qquad L \cdot s^2 \cdot C + RC \cdot s + 1 = 0$$

$$s_{1,2} = \frac{-RC \pm \sqrt{R^2 C^2 - 4 \cdot L \cdot C}}{2 \cdot LC} =$$

$$= -\frac{R}{2L} \pm \sqrt{\frac{R^2 C^2}{4L^2 C^2} - \frac{4 \cdot LC}{4 \cdot L^2 C^2}} =$$

$$= -\frac{R}{2L} \pm \sqrt{\frac{R^2}{4L^2} - \frac{1}{LC}}$$

$$D = \frac{R^2}{4L^2} - \frac{1}{LC} = \begin{cases} 0 & c.) \\ < 0 & b.) \\ > 0 & a.) \end{cases}$$

a)

$s_1, s_2 \in \mathbb{R}$

$$i(t) = c_1 \cdot e^{s_1 t} + c_2 \cdot e^{s_2 t}$$

$$i(0) = c_1 + c_2 = 0 \quad \longleftarrow c_1 = -c_2$$

$$L \cdot \frac{di(0)}{dt} = L \cdot \left(c_1 \cdot s_1 \cdot e^{s_1 t} + c_2 \cdot s_2 \cdot e^{s_2 t} \right) \Big|_{t=0} = u$$

$$u = L \cdot \left(-c_2 \cdot s_1 \cdot e^{s_1 t} + c_2 \cdot s_2 \cdot e^{s_2 t} \right) \Big|_{t=0} =$$

$$= L \cdot \left(-c_2 \cdot s_1 + c_2 \cdot s_2 \right) = L \left(s_2 - s_1 \right) \cdot c_2$$

$$\frac{u}{L(s_2 - s_1)} = c_2 \quad \Rightarrow \quad c_1 = -\frac{u}{L(s_2 - s_1)}$$

$$i(t) = -\frac{u}{L(s_2 - s_1)} \cdot e^{s_1 t} + \frac{u}{L(s_2 - s_1)} \cdot e^{s_2 t}$$

b) $s_1, s_2 \in \mathbb{C}$ ko $D < 0$

$s_1 = \alpha + i\beta$ $\alpha < 0$

$s_2 = \alpha - i\beta$

$i(t) = c_1 \cdot e^{(\alpha + i\beta)t} + c_2 \cdot e^{(\alpha - i\beta)t} = |c_1 e^{\alpha t} \cos\beta t + c_2 e^{\alpha t} \sin\beta t|$

$= A \cdot \sin(\beta t + \phi)$

$i(0) = c_1 + 0 = c_1 = 0$

$\frac{di}{dt}\Big|_{t=0} = L \cdot (c_2 (\underbrace{e^{\alpha t} \cdot \alpha \sin\beta t}_{0} + \underbrace{e^{\alpha t} \cdot \beta \cos\beta t}_{\beta}) = L \cdot c_2 \cdot \beta =$

$= U$

$c_2 = \frac{U}{L \cdot \beta}$

m.o

$i(t) = \frac{U}{L \cdot \beta} \cdot e^{\alpha t} \cdot \sin\beta t$

c)

$s_1, s_2 \in \mathbb{R}$

$s_1 = s_2 = s$

$i(t) = c_1 e^{st} + c_2 \cdot t \cdot e^{st}$

$i(0) = 0 = c_1 \cdot e^{st}\Big|_{t=0} = c_1 \rightarrow c_1 = 0$

$L \cdot \frac{di}{dt} = L \cdot (c_2 \cdot s \cdot e^{st} t + c_2 \cdot e^{st})_{t=0} = L \cdot c_2 = U \Rightarrow c_2 = \frac{U}{L}$

$i(t) = \frac{U}{L} \cdot e^{st} \cdot t$

b.) $s_1, s_2 \in \mathbb{C}$ ha $D < 0$

$s_1 = \alpha + i\beta \qquad \alpha < 0$

$s_2 = \alpha - i\beta$

$i(t) = c_1 \cdot e^{(\alpha + i\beta)t} + c_2 \cdot e^{(\alpha - \beta i)t} = \left| c_1 \cdot e^{\alpha t} \cos\beta t + c_2 \, e^{\alpha t} \cdot \sin\beta t \right|$

$= A \cdot \sin(\beta t + \phi)$

$i(0) = c_1 + 0 = c_1 = 0$

$\frac{di}{dt}\Big|_{t=0} = L \cdot \Big(c_2 \big(\underbrace{e^{\alpha t} \cdot \alpha \cdot \sin\beta t}_{0} + \underbrace{e^{\alpha t} \cdot \beta \cdot \cos\beta t}_{\beta}\big)\Big) = L \cdot c_2 \cdot \beta =$

$= U$

$c_2 = \frac{U}{L \cdot \beta}$

m.o.

$i(t) = \frac{U}{L \cdot \beta} \cdot e^{\alpha t} \cdot \sin\beta t$

.)

$s_1, s_2 \in \mathbb{R}$

$s_1 = s_2 = s$

$i(t) = c_1 \cdot e^{st} + c_2 \cdot t \cdot e^{st}$

$i(0) = 0 = c_1 \cdot e^{st}\Big|_{t=0} = c_1 \rightarrow c_1 = 0$

$L \cdot \frac{di}{dt} = L \cdot \left(c_2 \cdot s \cdot e^{st} t + c_2 \cdot e^{st}\right)_{t=0} = L \cdot c_2 = U \Rightarrow c_2 = \frac{U}{L}$

$i(t) = \frac{U}{L} \cdot e^{st} \cdot t$