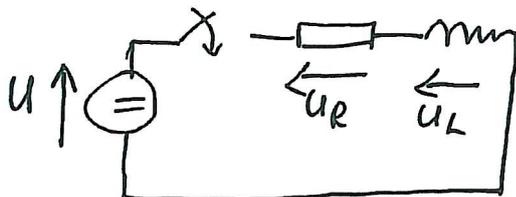


R-L-C áramkörök átmeneti jelenségei

Átmeneti jelenségek oka: $W(-0) \neq W(+0)$

1) R-L kör bekapcsolása



$$U_R(t) + U_L(t) = U(t)$$

$$Ri + L \frac{di}{dt} = U(t)$$

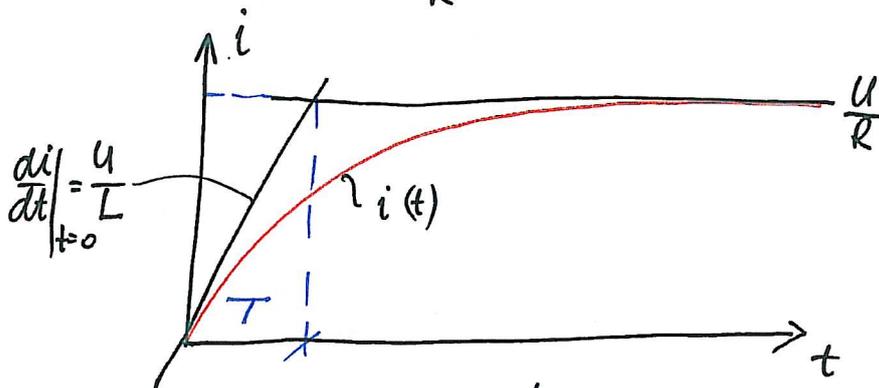
Megoldás

a) $i(-0) = i(+0) = 0$

b) Matematika

$$\left. \frac{di}{dt} \right|_{t=0} = \frac{U}{L}$$

$$i(\infty) = \frac{U}{R}$$



$$i = \frac{U}{R} \left(1 - e^{-\frac{t}{T}} \right)$$

$$i = \underbrace{\frac{U}{R}}_{i_{\text{d||}}} - \underbrace{\frac{U}{R} e^{-\frac{t}{T}}}_{i_{\text{trans}}}$$

$$i = i_{\text{d||}} + i_{\text{t}}$$

$$\frac{U/R}{T} = \frac{U}{L} \quad T = L/R$$

$$i = i_{\text{d||}} + i_{\text{t}}$$

$$R(i_{\text{d||}} + i_{\text{t}}) + L \frac{d}{dt}(i_{\text{d||}} + i_{\text{t}}) = U$$

$$\underbrace{R i_{\text{d||}} + L \frac{d i_{\text{d||}}}{dt}}_{\emptyset} + \underbrace{R i_{\text{t}} + L \frac{d i_{\text{t}}}{dt}}_{\emptyset} = U$$

$$\boxed{R i_{\text{t}} + L \frac{d i_{\text{t}}}{dt} = \emptyset}$$

Tranzienst ← homogén általános megoldás

Karakterisztikus egyenlet : $i_t = A e^{\lambda t}$

$$R i_t + L \frac{d i_t}{d t} = 0$$

$$(R + \lambda L) A e^{\lambda t} = 0$$

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

$$i_t = A e^{-\frac{R}{L} t} = \boxed{A} e^{-\frac{t}{T}} ; \boxed{T = \frac{L}{R}}$$

$$i = i_a' + i_t$$

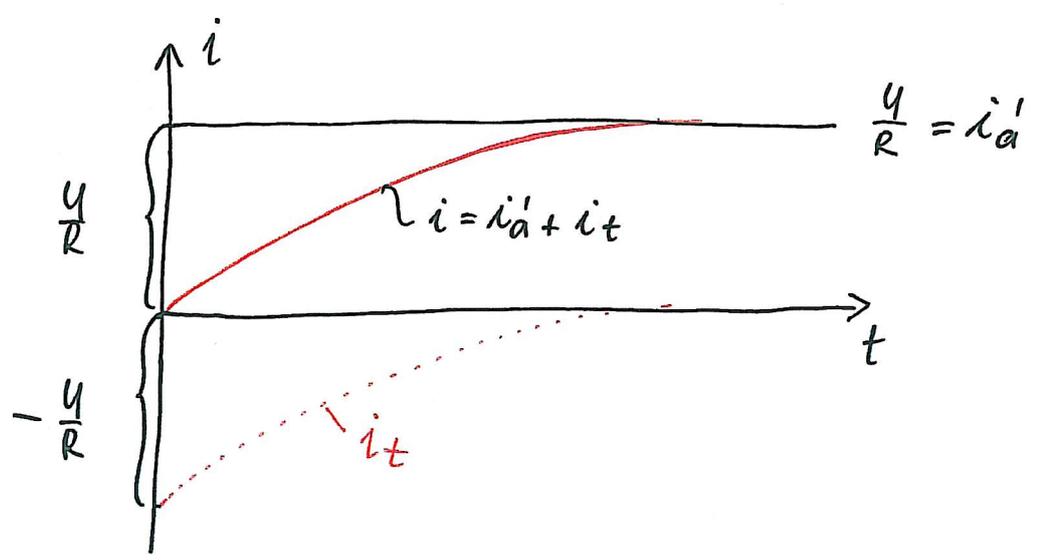
$$i = \frac{U}{R} + A e^{-\frac{t}{T}}$$

$$i(0) = 0 \leftarrow \text{Kezdeti feltétel}$$

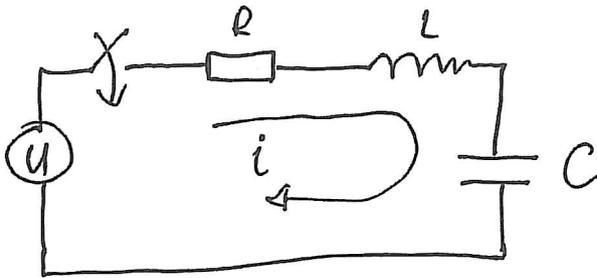
$$0 = \frac{U}{R} + A e^0$$

$$A = -\frac{U}{R}$$

$$\boxed{i_t = -\frac{U}{R} e^{-\frac{R}{L} t}}$$



2) R-L-C kör bekapcsolása



Csak a tranzienus öszoetevő etdekes

$$R i_t + L \frac{di_t}{dt} + \frac{1}{C} \int i_t dt = 0$$

$$i_t = \frac{dq_t}{dt}$$

$$L \frac{d^2 q_t}{dt^2} + R \frac{dq_t}{dt} + \frac{1}{C} q_t = 0$$

$$q_t = A e^{\lambda t}$$

$$\underbrace{\left(L \lambda^2 + R \lambda + \frac{1}{C} \right)}_{=0} A e^{\lambda t} = 0$$

$$\lambda_{1,2} = -\frac{R}{2L} \pm \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}$$

α ω_0^2

a) $D > 0$ mindkét gyök valós \rightarrow aperiodikus

$$\lambda_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2} = -\alpha \pm \beta$$

$$q_{tr} = A_1 e^{\lambda_1 t} + A_2 e^{\lambda_2 t} \Rightarrow i_{tr} = \underbrace{A_1 \lambda_1}_{\downarrow} e^{\lambda_1 t} + \underbrace{A_2 \lambda_2}_{\downarrow} e^{\lambda_2 t} = B_1 e^{\lambda_1 t} + B_2 e^{\lambda_2 t}$$

b) $D < 0$ gyökök konjugált komplexek \rightarrow periodikus

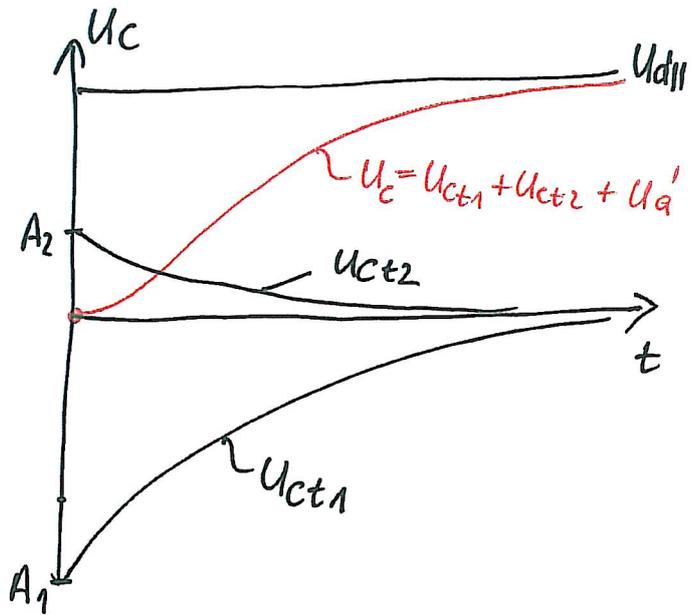
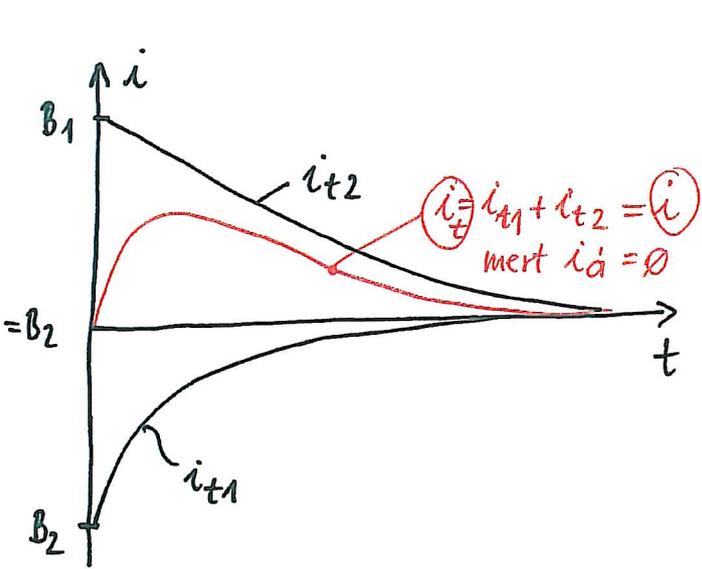
$$\lambda_{1,2} = -\alpha \pm j \sqrt{\omega_0^2 - \alpha^2} = -\alpha \pm j \omega_{cs}$$

$$i_t = e^{-\alpha t} \left[B_1 e^{j \omega_{cs} t} + B_2 e^{-j \omega_{cs} t} \right] \xrightarrow{\text{Euler}} \Rightarrow$$

$$i_t = B e^{-\alpha t} \sin(\omega_{cs} t + \delta)$$

hasolón $u_{ct} = C e^{-\alpha t} \cos(\omega_{cs} t + \delta)$

$D > 0$ aperiodikus



$D < 0$ periodikus

