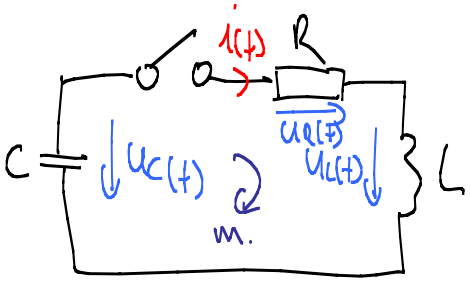
Note Title 08.11.2007



geg.: $U_{C(0)} = 100V$

$R = 560\Omega$

$L = 1000\,mH = 1000 \cdot 10^{-3}\,H$

$C = 100\,nF = 100 \cdot 10^{-9}\,F$

m: $-u_C + u_L + u_R = 0$

$$-u_C + L\frac{di}{dt} + iR = 0$$

$$-\frac{1}{C}\int i(t)\,dt + L\frac{di}{dt} + iR = 0 \quad | \frac{d}{dt}$$

$$-\frac{1}{C}i(t) + L\,i''(t) + i'R = 0$$

$$i''(t) + \frac{R}{L}i'(t) - \frac{1}{LC}i(t) = 0 \Rightarrow \text{DGL}$$

$$\Rightarrow s^2 + \frac{R}{L}s - \frac{1}{LC} = 0$$

$$s_{1,2} = \frac{-\frac{R}{L} \pm \sqrt{\left(\frac{R}{L}\right)^2 + \frac{4}{LC}}}{2} = -\frac{R}{2L} \pm \sqrt{\frac{R^2}{4L^2} + \frac{1}{LC}}$$

α α^2 ω_0^2

$$\alpha^2 = \frac{560^2}{4 \cdot (1000 \cdot 10^{-3})^2} = 7{,}84 \cdot 10^6\,\frac{1}{s^2}\,; \alpha = \frac{R}{2L} = 2800\,\frac{1}{s}$$

$$\omega_0^2 = \frac{1}{1000 \cdot 10^{-3} \cdot 100 \cdot 10^{-9}} = 10^8\,\frac{1}{s^2}$$

$\alpha^2 < \omega_0^2 \Rightarrow$ Schwingfall

$\omega_d = \sqrt{\omega_0^2 - \alpha^2}$

$= \sqrt{10^8 - 7{,}84 \cdot 10^6}$

$= 9600\ Hz$

Lösung: $i_{(t)} = B_1 \cdot e^{-\lambda t} \cos(\omega_d t) + B_2\, e^{-\lambda t} \sin(\omega_d t)$

$i_{(t=0)} = 0 \Rightarrow 0 = B_1 \cdot 1 \cdot 1 + B_2 \cdot 1 \cdot 0$

$\Rightarrow B_1 = 0$

$u_{C(t=0)} = 1000\,V$;

$i(0) = i(0+)$ da Strom stetig durch L

$u_C = L \frac{di}{dt} \Rightarrow \frac{di}{dt} = \frac{u_{C(0)}}{L}$

$i(t) = B_2\, e^{-\lambda t} \sin(\omega_d t) \quad / \frac{d}{dt}$

$\frac{di}{dt} = B_2 \left[-\lambda\, e^{-\lambda t} \sin(\omega_d t) + e^{-\lambda t} \omega_d \cos(\omega_d t) \right]$

$\frac{u_{C(0)}}{L} = B_2 \left[-\lambda \cdot 1 \cdot 0 + 1 \cdot \omega_d \cdot 1 \right]$

$\Rightarrow B_2 = \frac{u_{C(0)}}{L \cdot \omega_d} = \frac{1000}{100 \cdot 10^{-3} \cdot 9600} = 0{,}10416\,A$

$\Rightarrow i_{(t)} = 0{,}10416 \cdot e^{-2800 t} \sin(9600 t)\ A$

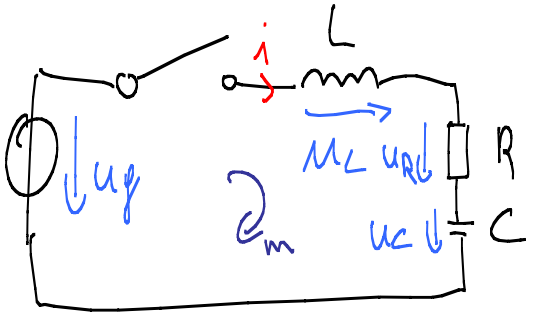
m: $u_C = Ri + L\frac{di}{dt}$

$= 560 \cdot 0{,}10416 \cdot e^{-2800t} \sin(9600t) +$

$100 \cdot 10^{-3} \cdot 0{,}10416 [(-2800 e^{-2800t}) \sin(9600t) +$

$e^{-2800t} 9600 \cos(9600t)]$

=



gg $L = 0{,}1\,H$

$R = 280\,\Omega$

$C = 400\,nF = 400 \cdot 10^{-9}\,F$

m: $u_L + u_R + u_C - u_g = 0$

$L\frac{di_L}{dt} + i \cdot R + \frac{1}{C}\int i\,dt - u_g = 0 \quad | \frac{d}{dt} \; | :L$

$i_{(t)}'' + \frac{R}{L} i_{(t)} + \frac{1}{LC} i_{(t)} = 0$

$\lambda^2 + \frac{R}{L}\lambda + \frac{1}{LC} = 0 \Rightarrow \lambda_{1,2} = \frac{-\frac{R}{L} \pm \sqrt{(\frac{R}{L})^2 - \frac{4}{LC}}}{2}$

$= \underbrace{\frac{R}{2L}}_{\alpha} \pm \sqrt{(\frac{R}{2L})^2 - \underbrace{\frac{1}{LC}}_{\omega_0^2}}$

$\alpha = \frac{280}{2 \cdot 0{,}1} = 1400\,\frac{1}{s}$

$\alpha^2 = 1{,}96 \cdot 10^6\,\frac{1}{s^2}$

$\omega_0^2 = \frac{1}{0{,}1 \cdot 400 \cdot 10^{-9}} = 2{,}5 \cdot 10^7\,\frac{1}{s^2}$

$\alpha^2 < \omega_0^2 \Rightarrow$ Schwingfall

$$\left(\frac{R}{2L}\right)^2 = \frac{1}{LC} \Rightarrow R = \sqrt{\frac{4L^2}{LC}} = \sqrt{\frac{4L}{C}} = \sqrt{\frac{4 \cdot 0{,}1}{400 \cdot 10^{-9}}}$$

für a-periodisch $R = 1000\,\Omega$

$$i(t) = B_1 e^{-\alpha t} \cos(\omega_d t) + B_2 e^{-\alpha t} \sin(\omega_d t)$$

$$\omega_d = \sqrt{\omega_0^2 - \alpha^2} = \sqrt{2{,}5 \cdot 10^7 - 1{,}96 \cdot 10^6} = 4800\ Hz$$

$$2\text{m}\ t = 0 : i = 0 \Rightarrow u_L = 0 \;;\; u_R = 0 \Rightarrow u_C = u_g$$

$$i(t = 0 = 0^+) = 0 \Rightarrow B_1 \cdot 1 \cdot 1 + B_2 \cdot 1 \cdot 0 \Rightarrow B_1 = 0$$

$$i(t = 0 = 0^+) = B_2 \cdot e^{-\alpha t} \cos(\omega_d t)$$

$$u_g = \frac{1}{C} \int i\, dt \quad / \cdot C \quad / \frac{d}{dt}$$

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

$$\frac{u_g C}{dt} = B_2 e^{-\alpha t} \cos(\omega_d t)$$

$$u_g C = B_2 \cdot \int e^{-\alpha t} \cdot \cos(\omega_d t)\, dt$$

$$u_g C = B_2 \frac{e^{-\alpha t} \sin(\omega_d t)\omega + (-\alpha) e^{-\alpha t} \cos(\omega_d t)}{\omega_d^2 + \alpha^2}$$

$$u_g C = B_2 \cdot \frac{1 \cdot 0 - \alpha \cdot 1}{\alpha^2 + \omega_d^2}$$

$$B_2 = \frac{U_g C (\alpha^2 + \omega d^2)}{-\alpha}$$

$$B_2 = \frac{48 \cdot 400 \cdot 10^{-6} (1400 + 4800^2)}{1400}$$

$$B_2 = -0,3159996\ A$$

$$i(t) = -0,3159996 \cdot e^{-1400t} \cos(4800t)$$

m: $U_C = U_g - U_R - U_L$

$$U_C = U_g - i(t) \cdot R - L \frac{di}{dt}$$

$$U_C = 48 - 280 \cdot (0,3159996 \cdot e^{-1400t} \cos(4800t)$$
$$- L \cdot (-0,3159996)[-1400 e^{-1400t} \cos(4800t)$$
$$- e^{-1400t} 4800 \sin(4800t)]$$