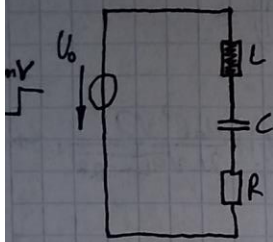


HWE-Hausübung

allgemein

Johannes Graussam



geg.: $f_0 = 7,077997 \text{ MHz}$, $Z_0 = 500 \Omega$, $Q = 10$

$$\omega_0 = 2\pi f_0 = 6,735558 \text{ MHz}$$

$$\omega_0 = \frac{1}{\sqrt{LC}} \quad Z_0 = \sqrt{\frac{L}{C}} \rightarrow L = C \cdot Z_0^2$$

$$\frac{1}{\omega_0^2} = LC \rightarrow C = \frac{1}{\omega_0^2 L} \approx 296,93 \text{ pF}$$

$$L = C \cdot Z_0^2 \approx 74,23 \mu\text{H}$$

$$R = \frac{Z_0}{Q}$$

$$R = 50 \Omega$$

$$U_0 = R \cdot I + L \cdot \frac{di}{dt} + U_C$$

$$U_0 = RC \frac{du_C}{dt} + LC \frac{d^2 u_C}{dt^2} + u_C$$

$$\ddot{u}_C + \frac{R}{L} \dot{u}_C + \frac{1}{LC} u_C = \frac{U_0}{LC}$$

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

$$\lambda_1 = -\frac{R}{2L} + \sqrt{\frac{4L - CR^2}{4CL^2}} j$$

$$\lambda_2 = -\frac{R}{2L} - \sqrt{\frac{4L - CR^2}{4CL^2}} j$$

$$u_C(t)_{\text{hom}} = e^{-\frac{R}{2L}t} \cdot (C_1 \cos(\sqrt{\dots}t) + C_2 \sin(\sqrt{\dots}t))$$

$$u_C(t)_p = U_0$$

$$u_C(t) = U_0 + u_C(t)_{\text{hom}}$$

$$\dot{u}_C(t) = -\frac{R}{2L} e^{-\frac{R}{2L}t} \cdot (C_1 \cos(\sqrt{\dots}t) + C_2 \sin(\sqrt{\dots}t))$$

$$+ e^{-\frac{R}{2L}t} \cdot (-\sqrt{\dots} \cdot (C_1 \sin(\sqrt{\dots}t) + \sqrt{\dots} C_2 \cos(\sqrt{\dots}t)))$$

$$0 = C_1 + U_0 \rightarrow C_1 = -U_0$$

$$0 = -\frac{R}{2L} C_1 + \sqrt{\frac{4L - CR^2}{4CL^2}} \cdot C_2$$

$$C_2 = -\frac{U_0 R}{2L \sqrt{\frac{4L - CR^2}{4CL^2}}} = -\frac{U_0 R \sqrt{C}}{\sqrt{4L - CR^2}}$$

$$u_C(t) = U_0 + e^{-\frac{R}{2L}t} \cdot (-U_0 \cos(\sqrt{\dots}t) - \frac{U_0 R \sqrt{C}}{\sqrt{4L - CR^2}} \cdot \sin(\sqrt{\dots}t))$$

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$$i(t) = C \cdot \frac{du_C(t)}{dt} = -\frac{RC}{2L} \cdot e^{-\frac{R}{2L}t} \cdot (-U_0 \cos(\sqrt{\frac{4L-CR^2}{4CL^2}} \cdot t) - \frac{U_0 R \cdot \sqrt{C}}{\sqrt{4L-CR^2}} \cdot \sin(\sqrt{\dots} \cdot t)) \\ + C \cdot e^{-\frac{R}{2L}t} \cdot (U_0 \cdot \sqrt{\dots} \cdot \sin(\sqrt{\dots} \cdot t) - \frac{U_0 R}{2L} \cdot \cos(\sqrt{\dots} \cdot t)) =$$

$$= C \cdot e^{-\frac{R}{2L}t} \cdot (U_0 \sqrt{\dots} \sin(\sqrt{\dots} \cdot t) - \cancel{\frac{U_0 R}{2L} \cos(\sqrt{\dots} \cdot t)} + \cancel{\frac{U_0 R}{2L} \cos(\sqrt{\dots} \cdot t)} + \frac{U_0 R^2 \sqrt{C}}{2L \sqrt{4L-CR^2}} \cdot \sin(\sqrt{\dots} \cdot t))$$

$$i(t) = U_0 \cdot C \cdot e^{-\frac{R}{2L}t} \cdot \left(\sqrt{\frac{4L-CR^2}{4CL^2}} + \frac{R^2 \sqrt{C}}{2L \sqrt{4L-CR^2}} \right) \sin(\sqrt{\dots} \cdot t) =$$

$$= \frac{2 \cdot U_0 \cdot C}{\sqrt{4LC-C^2R^2}} \cdot e^{-\frac{R}{2L}t} \cdot \sin\left(\sqrt{\frac{4L-CR^2}{4CL^2}} \cdot t\right)$$

$$i(t) = \frac{2 \cdot U_0 \cdot \sqrt{C}}{\sqrt{4L-CR^2}} \cdot e^{-\frac{R}{2L}t} \cdot \sin\left(\sqrt{\frac{4L-CR^2}{4CL^2}} \cdot t\right)$$

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