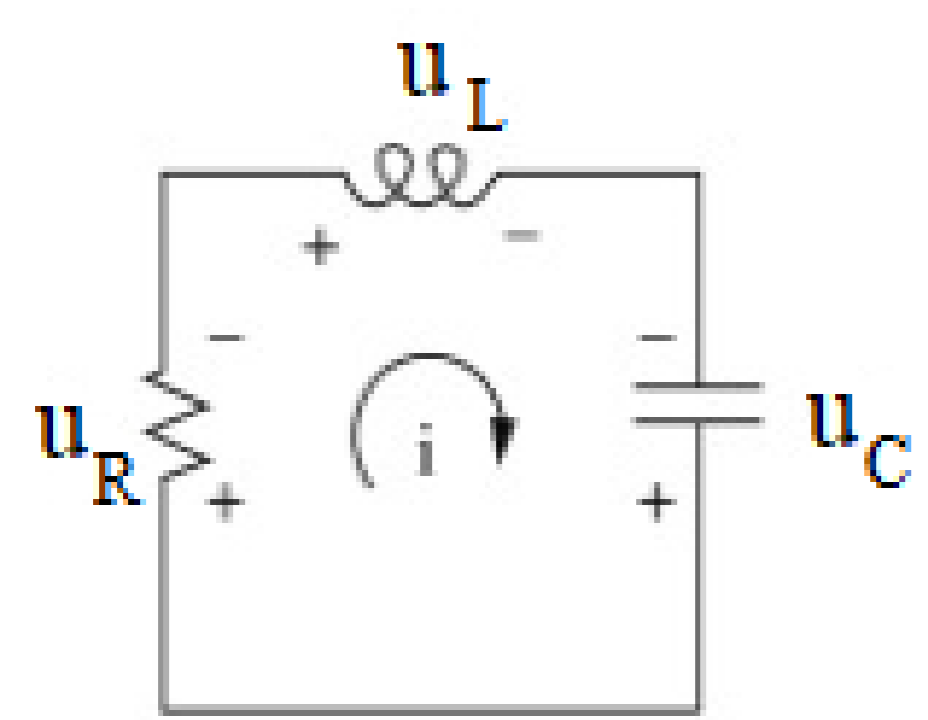


RLC



$$\hat{u}_R + \hat{u}_L + \hat{u}_C = 0$$

$$R \cdot i + L \frac{di}{dt} + \frac{q}{C} = 0 ; i = \frac{dq}{dt}$$

$$q(t_0=0) = q_0$$

$$Z(\omega) = R + j\left(\omega L - \frac{1}{\omega C}\right)$$

$$-Z(\omega) = 0 \Rightarrow Z(\omega)^2 = 0$$

$$Z(\omega)^2 = Z^* \cdot Z = R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2 = 0$$

$$R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2 = 0 \quad | \cdot (\omega C)^2$$

$$\omega^2 C^2 R^2 + (\omega^2 LC - 1)^2 = 0$$

$$\omega^2 C^2 R^2 = -(\omega^2 LC - 1)^2 \quad | \cdot \sqrt{\quad}$$

$$\omega C R = \pm j |\omega^2 LC - 1| \quad | \cdot j$$

$$(+)$$

$$j\omega RC = +j^2(\omega^2 LC - 1)$$

$$j\omega RC = 1 - \omega^2 LC$$

$$\omega^2 LC + jRC\omega - 1 = 0$$

$$\omega_{1,2} = \frac{-jRC \pm \sqrt{-R^2 C^2 + 4LC}}{2LC}$$

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

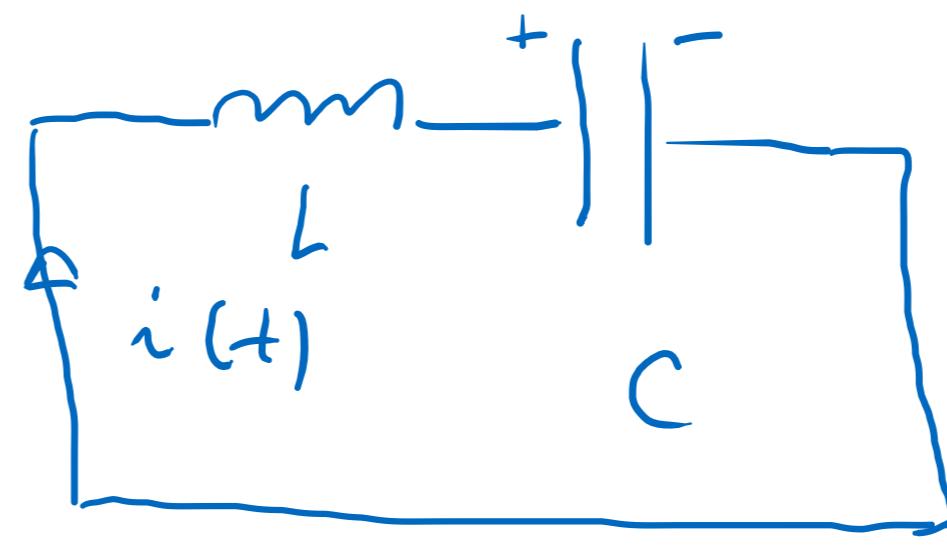
β ω_D

$$\omega_{1,2} = -j\beta \pm \omega_D$$

$$i = I_0 \cdot e^{j\omega_1 t} + I_0 \cdot e^{j\omega_2 t} = I_0 \cdot e^{+\beta t} \cdot e^{+j\omega_D t} + I_0 \cdot e^{+\beta t} \cdot e^{-j\omega_D t}$$

$\lim_{t \rightarrow \infty} e^{+\beta t} = \infty$ - none physical result

$$\omega_0 = \frac{1}{\sqrt{LC}} \quad \text{Thomson-formula}$$



$$Z(\omega) = \left(\omega L - \frac{1}{\omega C}\right) \cdot j$$

$$\omega_0 L = \frac{1}{\omega_0 C}$$

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$(-)$$

$$j\omega RC = -j^2(\omega^2 LC - 1)$$

$$j\omega RC = \omega^2 LC - 1$$

$$\omega^2 LC - jRC\omega - 1 = 0$$

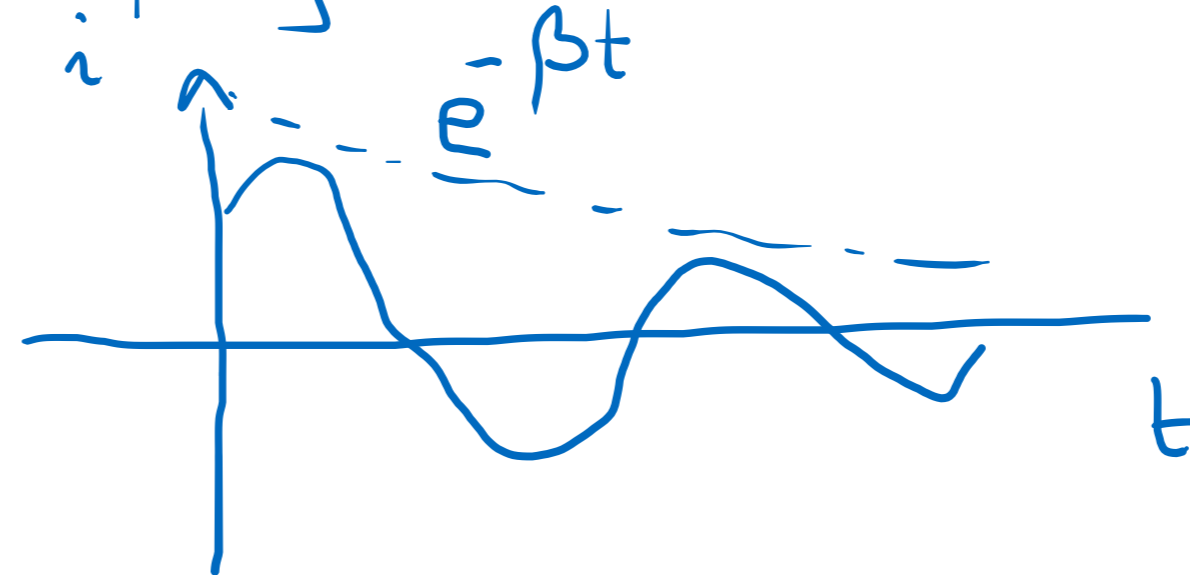
$$\omega_{1,2} = \frac{jRC \pm \sqrt{R^2 C^2 - 4LC}}{2LC}$$

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

$$\omega_{1,2} = j\beta \pm \omega_D$$

$$i(t) = I_0 \cdot e^{j\omega_1 t} + I_0 \cdot e^{j\omega_2 t} = I_0 \cdot e^{-\beta t} \cdot e^{+j\omega_D t} + I_0 \cdot e^{-\beta t} \cdot e^{-j\omega_D t}$$

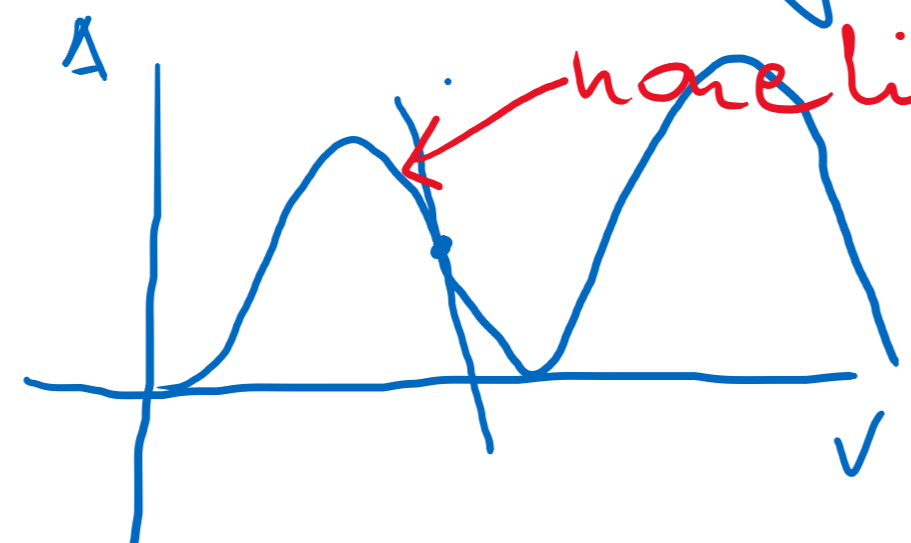
real physical solution



$$\beta = R/2L = -|R_d|/2L$$

$$i = e^{\frac{R_d}{2L} t} \cdot [e^{+j\omega_D t} + e^{-j\omega_D t}]$$

ω_D - microwave range



nonlinear behavior around working point

microwave generation with nonlinear oscillations for large changes in voltage