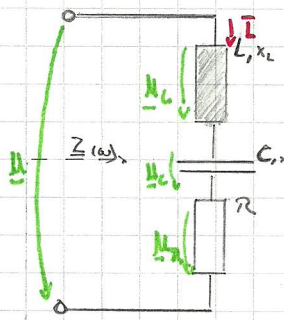
## 0) Vorbereitung:

$R = 10\,\Omega$ $\qquad L = 10\,mH$ $\qquad C = 20\,\mu F$

ges. -□-|-|-□- & ⊡, die $f_0$, $Q_{r/p}$; $f_{go}$, $f_{gu}$, $f_{res}$, $Z_{res}$, $Q_L$

### a) Reihenschwingkreis



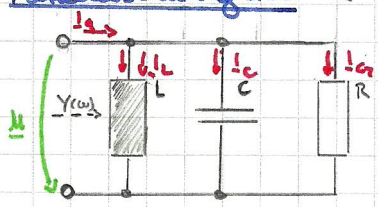

$$f_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10mH \cdot 20\mu F}} = \underline{355\ Hz}$$ (Resonanzfrequenz)

$$Q_r = \frac{1}{R}\cdot\sqrt{\frac{L}{C}} = \frac{1}{10\Omega}\cdot\sqrt{\frac{10mH}{20\mu F}} = \sqrt{5} = \underline{2{,}2}$$ (Güte des Reihenschwingkreis)

$$f_{go} = f_0\left(\sqrt{1+\left(\frac{1}{2Q_r}\right)^2} + \frac{1}{2Q}\right) = 355\,Hz\left(\sqrt{1+\frac{1}{4{,}5}} + \frac{1}{2\sqrt{5}}\right) = \underline{443\,Hz}$$

$$f_{gu} = f_0\left(\sqrt{1+\left(\frac{1}{2Q_r}\right)^2} - \frac{1}{2Q}\right) = \underline{284\ Hz}$$

### b) Parallelschwingkreis $\quad R = \frac{1}{G}$




$$f_0 = \frac{1}{2\pi\sqrt{LC}} = 355\,Hz$$

$$Q_p = \frac{1}{G}\cdot\sqrt{\frac{C}{L}} = \frac{1}{10S}\cdot\sqrt{\frac{20\mu F}{10mH}} = \underline{\frac{\sqrt{5}}{5}}$$

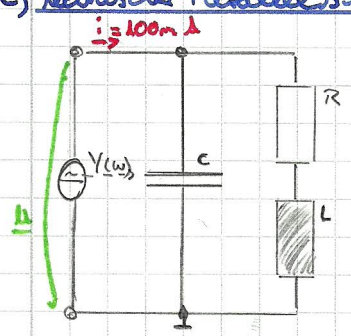
$$f_{go} = \cancel{443\,Hz} = f_0\left(\sqrt{1+\left(\frac{1}{2Q_p}\right)^2} + \frac{1}{2Q}\right) = 355\,Hz\cdot\left(\sqrt{1+\left(\frac{1}{2\cdot\frac{\sqrt{5}}{5}}\right)^2} + \frac{1}{2\cdot\frac{\sqrt{5}}{5}}\right)$$

$$\cancel{f_{go} = 284\,Hz}$$

$$= 355\,Hz\left(\sqrt{1+1{,}25} + \frac{5}{2\sqrt{5}}\right) = \underline{929\ Hz}$$

$$f_{gu} = f_0\left(\sqrt{1+\left(\frac{1}{2Q_p}\right)^2} - \frac{1}{2Q_p}\right) = 355\left(\sqrt{2{,}25} - \frac{5}{2\sqrt{5}}\right) = \underline{135\ Hz}$$

### c) technischer Parallelschwingkreis




$$\underline{Y}(\omega) = j\omega C + \frac{1}{R+j\omega L} = \frac{R}{R^2+\omega^2L^2} + j\left(\omega C - \frac{\omega L}{R^2+\omega^2L^2}\right)$$

$$\omega_{res} = \frac{1}{\sqrt{LC}}\cdot\sqrt{1-R^2\frac{C}{L}} = \frac{1}{\sqrt{10mH\cdot 20\mu F}}\cdot\sqrt{1-10\Omega\frac{20\mu F}{10mH}} = \underline{2000\,\frac{rad}{s}}$$

$$Y_{res} = \frac{R}{R^2+\omega_{res}^2\cdot L^2} \rightarrow Z_{res} = R + \frac{\omega_{res}^2\cdot L^2}{R} = 10\Omega + \frac{\left(2000\frac{rad}{s}\right)^2\cdot(10mH)^2}{10\Omega}$$

$$= \underline{50\,\Omega}$$

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}\cdot\sqrt{1-R^2\frac{C}{L}} = \frac{1}{2\pi}\cdot\omega_{res} = \frac{1}{2\pi}\cdot 2000\frac{rad}{s} = \underline{318\,Hz}$$

$$Q = \frac{\omega_{res}\cdot L}{R} = \frac{2000\frac{rad}{s}\cdot 10mH}{10\Omega} = \underline{2}$$