

1. Jak velký musí být maximální indukční tok Φ_0 , aby se v jednom závitě indukovalo efektivní napětí $U_{ef} = 0,25V$? Frekvence je $f = 50Hz$.

$$\Phi_0 = ?$$

$$f = 50Hz$$

$$U_{ef} = 0,25V$$

$$U = -\frac{d\Phi}{dt}$$

$$\Phi = \Phi_0 \cdot \sin(\omega t)$$

$$-\frac{d\Phi}{dt} = \underbrace{-\Phi_0 \cdot \omega}_{U_m} \cdot \cos(\omega t)$$

$$U_m = \sqrt{2} \cdot U_{ef} = -\Phi_0 \cdot \omega = -\Phi_0 \cdot 2 \cdot \pi \cdot f \Rightarrow \Phi_0 = -\frac{\sqrt{2} \cdot U_{ef}}{2 \cdot \pi \cdot f} = -\frac{\sqrt{2} \cdot 0,25}{2 \cdot \pi \cdot 50} = -1,1254 \cdot 10^{-3} Wb$$

2. Parametry cívky jsou: $N = 10^4$, $\ell = 50cm$, $S = 2cm^2$, $R = 20\Omega$, $\sim U = 100V$. Jaká musí být frekvence f , aby induktivní odpor byl roven ohmickému odporu?

$$N = 10^4$$

$$\ell = 50cm = 0,5m$$

$$S = 2cm^2 = 2 \cdot 10^{-4}m^2$$

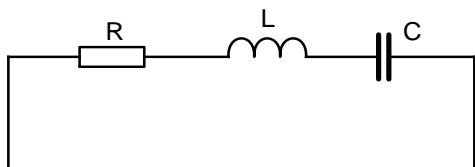
$$R = 20\Omega$$

$$X_L = \omega L = R$$

$$L = \frac{\mu_0 \cdot N^2 \cdot S}{\ell}$$

$$\omega \cdot \frac{\mu_0 \cdot N^2 \cdot S}{\ell} = R \Rightarrow \omega = 2 \cdot \pi \cdot f = \frac{R \cdot \ell}{\mu_0 \cdot N^2 \cdot S} \Rightarrow f = \frac{R \cdot \ell}{2 \cdot \pi \cdot \mu_0 \cdot N^2 \cdot S} = \frac{20 \cdot 0,5}{2 \cdot \pi \cdot 4 \cdot \pi \cdot 10^{-7} \cdot (10^4)^2 \cdot 2 \cdot 10^{-4}} = 63,3257Hz$$

3. Do série zapojeno: $R = 10\Omega$, $C = 2\mu F$, $L = 0,1H$. Připojené napětí $\sim U = 200V$, frekvence $f = 50Hz$. Jak veliký je proud $\hat{I} = ?$



$$R = 10\Omega$$

$$C = 2\mu F = 2 \cdot 10^{-6}F$$

$$L = 0,1H$$

$$\sim U = 220V$$

$$f = 50Hz$$

$$\hat{I} = ?$$

$$\hat{I} = \frac{U}{\hat{Z}} = U \cdot \hat{Y}$$

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

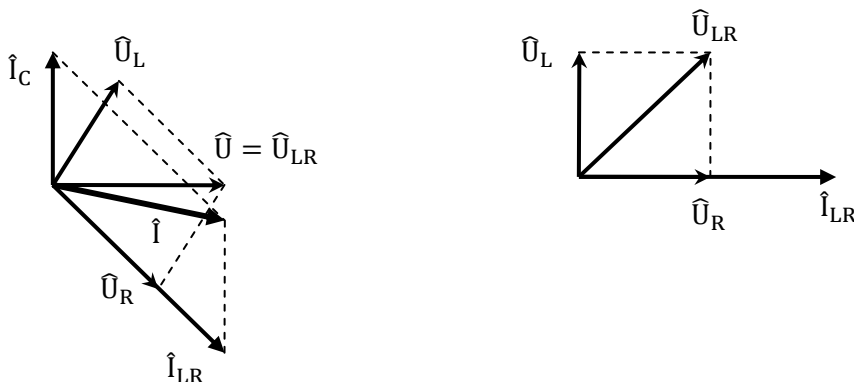
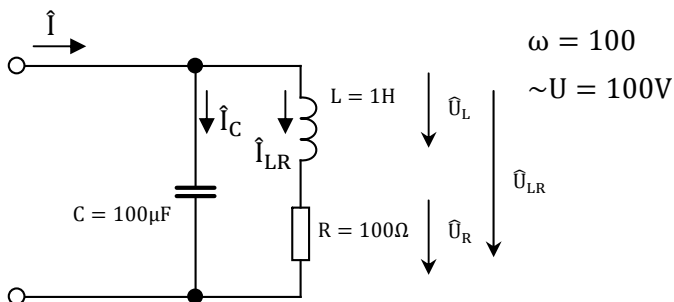
$$\hat{Y} = \frac{1}{\hat{Z}} = \frac{1}{R + j \cdot \left(\omega L - \frac{1}{\omega C} \right)} \cdot \frac{R - j \cdot \left(\omega L - \frac{1}{\omega C} \right)}{R - j \cdot \left(\omega L - \frac{1}{\omega C} \right)} = \frac{R - j \cdot \left(\omega L - \frac{1}{\omega C} \right)}{R^2 + \left(\omega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

$$\begin{aligned} \hat{I} = U \cdot \hat{Y} &= U \cdot \frac{R - j \cdot \left(\omega L - \frac{1}{\omega C} \right)}{R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2} = \frac{R \cdot U}{R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2} + j \cdot \left[-\frac{U \cdot \left(\omega L - \frac{1}{\omega C} \right)}{R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2} \right] = \\ &= \frac{10 \cdot 220}{10^2 + \left(2 \cdot \pi \cdot 50 \cdot 0,1 - \frac{1}{2 \cdot \pi \cdot 50 \cdot 2 \cdot 10^{-6}} \right)^2} + \\ &+ j \cdot \left[-\frac{220 \cdot \left(2 \cdot \pi \cdot 50 \cdot 0,1 - \frac{1}{2 \cdot \pi \cdot 50 \cdot 2 \cdot 10^{-6}} \right)}{10^2 + \left(2 \cdot \pi \cdot 50 \cdot 0,1 - \frac{1}{2 \cdot \pi \cdot 50 \cdot 2 \cdot 10^{-6}} \right)^2} \right] = \frac{9,038 \cdot 10^{-4}}{\text{Re } \hat{I}} + j \cdot \frac{(-0,141)}{\text{Im } \hat{I}} \end{aligned}$$

$$|\hat{I}| = \sqrt{(\text{Re } \hat{I})^2 + (\text{Im } \hat{I})^2} = \sqrt{(9,038 \cdot 10^{-4})^2 + (-1,141)^2} = 0,141 \text{ A}$$

$$\varphi = \text{artctg} \frac{\text{Im } \hat{I}}{\text{Re } \hat{I}} = \text{artctg} \frac{-0,141}{9,038 \cdot 10^{-4}} = -1,564 \text{ rad}$$

4. Vypočítejte proud $\hat{I} = ?$. Nakreslete fázorový diagram.



$$\hat{Z}_{LR} = R + j\omega L$$

$$\hat{Y}_{LR} = \frac{1}{\hat{Z}_{LR}} = \frac{1}{R + j\omega L} \cdot \frac{R - j\omega L}{R - j\omega L} = \frac{R - j\omega L}{R^2 + \omega^2 L^2} = \frac{R}{R^2 + \omega^2 L^2} - j \cdot \frac{\omega L}{R^2 + \omega^2 L^2}$$

$$\hat{Y} = \hat{Y}_C + \hat{Y}_{LR} = j\omega C + \frac{R}{R^2 + \omega^2 L^2} - j \cdot \frac{\omega L}{R^2 + \omega^2 L^2} = \frac{R}{R^2 + \omega^2 L^2} + j \cdot \left(\omega C - \frac{\omega L}{R^2 + \omega^2 L^2} \right)$$

$$\begin{aligned} \hat{I} &= \frac{U}{\hat{Z}} = U \cdot \hat{Y} = U \cdot \left[\frac{R}{R^2 + \omega^2 L^2} + j \cdot \left(\omega C - \frac{\omega L}{R^2 + \omega^2 L^2} \right) \right] = \\ &= 100 \cdot \left[\frac{100}{100^2 + 100^2 \cdot 1^2} + j \cdot \left(100 \cdot 100 \cdot 10^{-6} - \frac{100 \cdot 1}{100^2 + 100^2 \cdot 1^2} \right) \right] = \\ &= 100 \cdot [5 \cdot 10^{-3} + j \cdot 5 \cdot 10^{-3}] = 0,5 + j \cdot 0,5 \end{aligned}$$

$$|\hat{I}| = \sqrt{(0,5)^2 + (0,5)^2} = \sqrt{\frac{1}{2}} = \frac{\sqrt{2}}{2} \text{ A}$$

$$\varphi = \operatorname{arctg} \frac{0,5}{0,5} = \frac{\pi}{4}$$