

Prověřka "stridavy proud2" - řešení

R5.321 $f = 50 \text{ Hz}$, $U_m = 200 \text{ V}$, $t_1 = 2,5 \text{ ms} = 2,5 \cdot 10^{-3} \text{ s}$, $t_2 = 4,0 \text{ ms} = 4,0 \cdot 10^{-3} \text{ s}$, $t_3 = 5,0 \text{ ms} = 5,0 \cdot 10^{-3} \text{ s}$; $u = ?$

$$u = U_m \sin \omega t$$

$$\{u_1\} = 200 \sin 100\pi \{t_1\} = 200 \sin \pi/4 = 140, \quad u_1 = 140 \text{ V}$$

$$\{u_2\} = 200 \sin 100\pi \{t_2\} = 200 \sin 2\pi/5 = 190, \quad u_2 = 190 \text{ V}$$

$$\{u_3\} = 200 \sin 100\pi \{t_3\} = 200 \sin \pi/2 = 200, \quad u_3 = 200 \text{ V}$$

R5.330 $f = 50 \text{ Hz}$, $U = 24 \text{ V}$, $I = 0,5 \text{ A}$; $L = ?$

$$X_L = \frac{U}{I} = \omega L$$

$$L = \frac{U}{I \cdot 2\pi f} = 0,15 \text{ H}$$

R5.332 $L = 200 \text{ mH} = 0,2 \text{ H}$, $f_1 = 50 \text{ Hz}$, $f_2 = 400 \text{ Hz}$; $X_L = ?$

$$X_{L1} = \omega_1 L = 2\pi f_1 L = 63 \Omega$$

$$X_{L2} = \omega_2 L = 2\pi f_2 L = 500 \Omega$$

R5.333 $f = 500 \text{ Hz}$, $X_L = 35 \Omega$; $L = ?$

$$L = \frac{X_L}{2\pi f} = 1,1 \cdot 10^{-2} \text{ H} = 11 \text{ mH}$$

R5.334 $L_1 = 1,6 \text{ H}$, $L_2 = 0,63 \text{ mH} = 6,3 \cdot 10^{-4} \text{ H}$, $X_L = 1 \text{ k}\Omega = 10^3 \Omega$; $f = ?$

$$f_1 = \frac{X_L}{2\pi L_1} = 100 \text{ Hz}$$

$$f_2 = \frac{X_L}{2\pi L_2} = 2,5 \cdot 10^5 \text{ Hz} = 0,25 \text{ MHz}$$

R5.336 $C = 4,0 \mu\text{F} = 4,0 \cdot 10^{-6} \text{ F}$, $f = 50 \text{ Hz}$; $L = ?$

$$X_L = X_C$$

$$\omega L = \frac{1}{\omega C} \Rightarrow L = \frac{1}{\omega^2 C} = \frac{1}{4\pi^2 f^2 C} = 2,5 \text{ H}$$

R5.337 $C = 2,0 \mu\text{F} = 2,0 \cdot 10^{-6} \text{ F}$, $f = 500 \text{ Hz}$; $f_1 = ?$, $f_2 = ?$

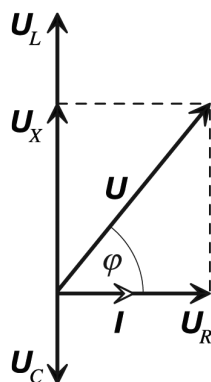
a) $C_1 = 2C$

$$X_{C1} = \frac{1}{2\pi f C} = \frac{1}{2\pi f_1 2C} \Rightarrow f_1 = \frac{f}{2} = 250 \text{ Hz}$$

b) $C_2 = C/2$

$$X_{C2} = \frac{1}{2\pi f C} = \frac{1}{2\pi f_2 C/2} \Rightarrow f_2 = 2f = 1000 \text{ Hz}$$

R5.340 Obr. R5-340.



Obr. R5-340

Z obr. 5-325 [5-68] najdeme $U_m = 80 \text{ V}$, $I_m = 2 \text{ A}$ a fázový posun střídavého napětí vzhledem k proudu v obvodu $\varphi = \pi/4$:

$$Z = \frac{U_m}{I_m} = 40 \, \Omega$$

$$R = X = \frac{U_R}{I_m} = \frac{U_m \sin \varphi}{I_m} \approx 0,7Z = 28 \, \Omega$$

R5.343 $R = 40 \, \Omega$, $L = 0,40 \text{ H}$, $C = 16 \, \mu\text{F} = 1,6 \cdot 10^{-5} \text{ F}$, $U_m = 12 \text{ V}$, $f = 50 \text{ Hz}$; $I_m = ?$, $\varphi = ?$

Pro impedanci obvodu platí vztah:

$$Z = \frac{U_m}{I_m} = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$I_m = \frac{U_m}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}} = 0,14 \text{ A}$$

Amplitudy napětí na obvodových prvcích mají hodnoty:

$$U_R = I_m R = 5,6 \text{ V}$$

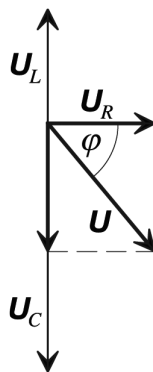
$$U_L = I_m \omega L = 18 \text{ V}$$

$$U_C = \frac{I_m}{\omega C} = 28 \text{ V}$$

Z těchto hodnot sestojíme fázorový diagram (obr. R5-343 [5-71]) a určíme fázový rozdíl:

$$\tan \varphi = \frac{U_L - U_C}{U_R} = \frac{\omega L - \frac{1}{\omega C}}{R} \approx -1,8$$

$$\varphi \approx -61^\circ$$



Obr. 5-343

Amplituda proudu v obvodu je 0,14 A a celkové napětí na obvodu se za proudem opožďuje o 61° . To znamená, že obvod jako celek má vlastnost kapacitance.

R5.344 $L = 50 \text{ mH} = 5,0 \cdot 10^{-2} \text{ H}$, $R = 10 \text{ } \Omega$, $C = 2,0 \text{ } \mu\text{F} = 2,0 \cdot 10^{-6} \text{ F}$, $I_m = 100 \text{ mA} = 0,1 \text{ A}$,
 $f = 0,5 \text{ kHz} = 5 \cdot 10^2 \text{ Hz}$; $Z = ?$, $U_m = ?$

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \approx 10 \text{ } \Omega$$

$$U_m = ZI_m = 1 \text{ V}$$

R5.346 $R = 1,0 \text{ k}\Omega = 10^3 \text{ } \Omega$, $L = 0,50 \text{ H}$, $C = 1,0 \text{ } \mu\text{F} = 1,0 \cdot 10^{-6} \text{ F}$, $f_1 = 50 \text{ Hz}$, $f_2 = 10 \text{ kHz} = 10^4 \text{ Hz}$; X_L
 $= ?$, $X_C = ?$, $Z = ?$

a) $f_1 = 50 \text{ Hz}$

$$X_L = \omega L = 160 \text{ } \Omega$$

$$X_C = \frac{1}{\omega C} = 3,2 \cdot 10^3 \text{ } \Omega = 3,2 \text{ k}\Omega$$

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} = 3,2 \cdot 10^3 \text{ } \Omega = 3,2 \text{ k}\Omega$$

b) $f_2 = 10^4 \text{ Hz}$

$$X_L = 31 \text{ k}\Omega; X_C = 16 \text{ } \Omega; Z = 31 \text{ k}\Omega$$

R5.349 $R_1 = 3,0 \text{ } \Omega$, $X_{L1} = 4,0 \text{ } \Omega$, $R_2 = 6,0 \text{ } \Omega$, $X_{C2} = 8,0 \text{ } \Omega$, $R_3 = 12 \text{ } \Omega$, $X_{C3} = 8,0 \text{ } \Omega$, $X_{L3} = 20 \text{ } \Omega$; $Z = ?$

$$\text{a) } Z_1 = \sqrt{R_1^2 + X_{L1}^2} = 5 \text{ } \Omega$$

$$\text{b) } Z_2 = \sqrt{R_2^2 + X_{C2}^2} = 10 \text{ } \Omega$$

$$\text{c) } Z_3 = \sqrt{R_3^2 + (X_{L3} - X_{C3})^2} = 17 \text{ } \Omega$$

R5.351 $f = 50 \text{ Hz}$, $C = 15 \text{ } \mu\text{F} = 1,5 \cdot 10^{-5} \text{ F}$; $L = ?$

Napětí na části obvodu LC je nulové při rezonanci, tzn. když $X_L = X_C$. Pak platí:

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

$$L = \frac{1}{\omega^2 C} = 0,68 \text{ H}$$

$$\mathbf{R5.368} \quad U_1 = 380 \text{ V}, U_2 = 220 \text{ V}, U_3 = 120 \text{ V}; U_m = ?$$

$$U_m = U\sqrt{2} \approx 1,41U$$

$$U_{m1} = 537 \text{ V}, U_{m2} = 311 \text{ V}, U_{m3} = 170 \text{ V}$$

$$\mathbf{R5.375} \quad U = 220 \text{ V}, I = 10 \text{ A}, P = 2,0 \text{ kW} = 2,0 \cdot 10^3 \text{ W}; \cos \varphi = ?, \varphi = ?$$

$$\cos \varphi = \frac{P}{UI} = 0,91$$

$$\varphi = 24^\circ 30' \approx 25^\circ$$

$$\mathbf{R5.376} \quad U = 220 \text{ V}, P = 2,2 \text{ kW} = 2,2 \cdot 10^3 \text{ W}, \cos \varphi = 0,80; I = ?$$

$$I = \frac{P}{U \cos \varphi} = 12,5 \text{ A}$$

$$\mathbf{R5.394} \quad U_1 = 2,0 \text{ kV} = 2 \cdot 10^3 \text{ V}, I_1 = 2,0 \text{ A}, \cos \varphi = 0,82, U_2 = 220 \text{ V}; I_2 = ?, P_2 = ?$$

$$U_1 I_1 = U_2 I_2 \Rightarrow I_2 = \frac{U_1 I_1}{U_2} = 18 \text{ A}$$

$$P_2 = U_2 I_2 \cos \varphi = 3300 \text{ W} = 3,3 \text{ kW}$$