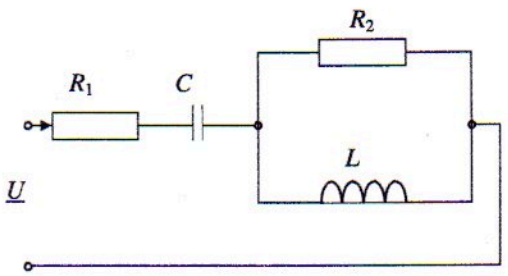
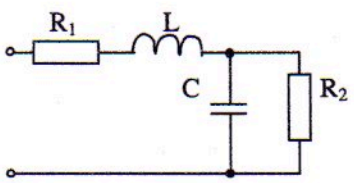
4.a domača naloga iz Osnov elektrotehnike II

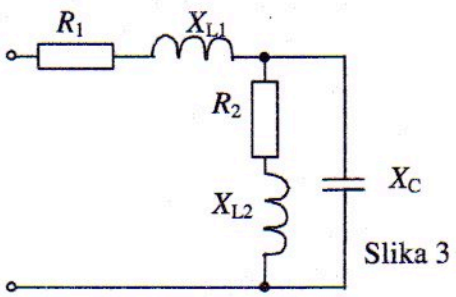
1. V vezju na sliki določite R_2 tako, da bo vezje v resonanci pri krožni frekvenci $\omega_0 = 1000\ s^{-1}$ ($L = 60$ mH, $R_1 = 40\ \Omega$, $C = 30\ \mu$F).



2. V vezju na sliki določite R_2 tako, da bo vezje pri $\omega_o = 1000$ Hz v resonanci. $L = 10$ mH, $R_1 = 25\ \Omega$ in $C = 50\ \mu$F.



3. V vezju na sliki določite X_C tako, da bo vezje v resonanci. $X_{L1} = 10\ \Omega$, $R_1 = 8\ \Omega$, $R_2 = 10\ \Omega$ in $X_{L2} = 12\ \Omega$.



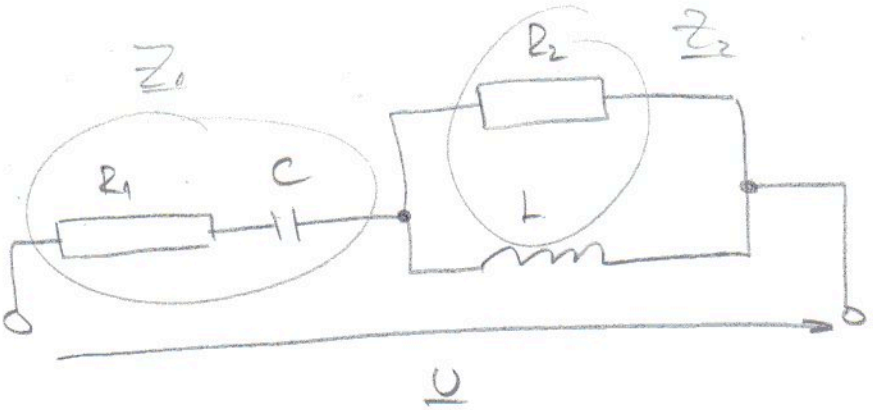
Slika 3

Rešitve:

1. $R_2 = 67{,}08\ \Omega$
2. $R_2 = 20\ \Omega$
3. $X_{C1} = 14{,}57\ \Omega$ (14,18)
   $X_{C2} = 7{,}61\ \Omega$ (7,82)

4.a DN

1. malooga



$\omega_0 = 1000\ s^{-1}$

$L = 60\ mH$

$R_1 = 40\ \Omega$

$C = 30\ \mu F$

R_2? da bo vezje v resonanci

$$\underline{Z} = R + j(X_L - X_C)$$

$$X_L = \omega_0 L = 60 \cdot 10^{-3} \cdot 1 \cdot 10^{3} = 60\ \Omega$$

$$X_C = \frac{1}{\omega_0 C} = \frac{1}{1 \cdot 10^{3} \cdot 30 \cdot 10^{-6}} = 33{,}33\ \Omega$$

$$\underline{Z} = \underline{Z}_1 + \underline{Z}_2$$

$$\underline{Z} = 40 - j\frac{100}{3}\ \Omega + \frac{j60R_2}{j60 + R_2}$$

$$\underline{Z}_2 = \frac{R_2 \cdot jX_L}{R_2 + jX_L}$$

$$\underline{Z}_2 = \frac{j60R_2}{j60 + R_2}$$

$$\underline{Z} = 40 - j\frac{100}{3} + \frac{(j60R_2)\cdot(R_2 - j60)}{+3600 + R_2^2}$$

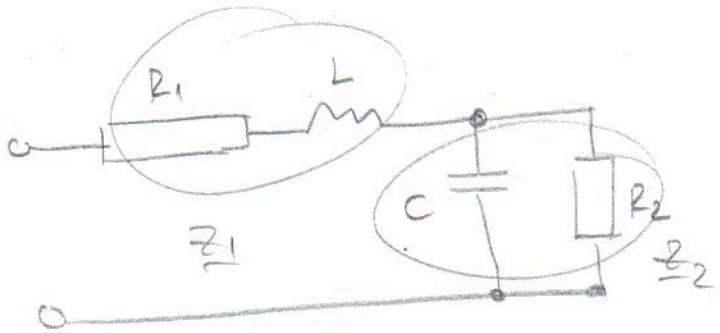
$$\underline{Z} = 40 - j\frac{100}{3} + \frac{j60R_2^2 + 3600R_2}{+3600 + R_2^2}$$

$$\frac{60R_2^2}{+3600 + R_2^2} = \frac{100}{3}$$

$$180R_2^2 = +360000 + 100R_2^2$$

$$R_2 = \sqrt{4500} = 67{,}08\ \Omega$$

2 metoda



$\omega_0 = 1000\ Hz$

$L = 10\ mH$

$R_1 = 25\ \Omega$

$C = 50\ \mu F$

$R_2 = ?$, dla bo rezja w rezonansie! $\quad Im(\underline{Z}) = \phi$

$$X_L = \omega_0 L = 1 \cdot 10^3 \cdot 10 \cdot 10^{-3} = 10\ \Omega$$

$$X_C = \frac{1}{\omega_0 C} = \frac{1}{1 \cdot 10^3 \cdot 50 \cdot 10^{-6}} = 20\ \Omega$$

$$\underline{Z} = \underline{Z}_1 + \underline{Z}_2$$

$$\underline{Z}_2 = \frac{-jX_C R_2}{R_2 - jX_C} = \frac{-j20R_2}{R_2 - j20}$$

$$\underline{Z} = 25 + j10\ \Omega + \frac{-j20R_2}{R_2 - j20}$$

$$\underline{Z} = 25 + j10 + \frac{-j20R_2^2 - 400R_2}{R^2 + 400}$$

$$Im(\underline{Z}) = \phi$$

$$j10 - \frac{j20R_2^2}{R^2 + 400} = \phi$$

$$\frac{10}{1} = \frac{20R_2^2}{R_2^2 + 400}$$

$$20R_2^2 - 10R_2^2 - 4000 = \phi$$

$$R_2^2 (20 - 10) = 4000$$

$$R_2 = \sqrt{\frac{4000}{10}} = 20\ \Omega$$

(3.)

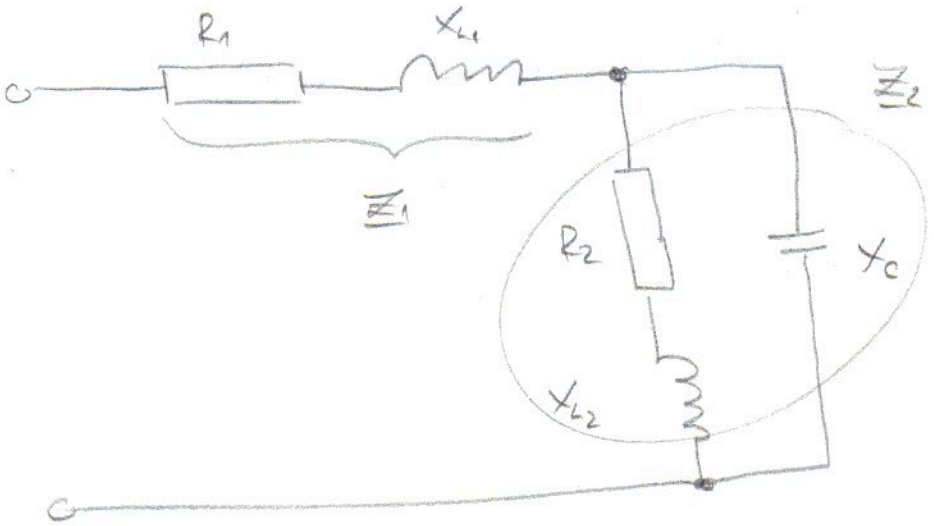
$X_L = 10\ \Omega$

$X_{L2} = 12\ \Omega$

$R_1 = 8\ \Omega$

$R_2 = 10\ \Omega$

$X_C = ?$, da bo $\mathrm{Im}(\underline{Z}) = 0$



$$\underline{Z} = \underline{Z}_1 + \underline{Z}_2$$

$$\underline{Z}_1 = 8 + j10\ \Omega$$

$$\underline{Z}_2 = \frac{(10 + j12)\cdot(-jX_C)}{10 + j(12 - X_C)} = \frac{12X_C - j10X_C}{10 + j(12 - X_C)}$$

$$\underline{Z} = 8 + j10 - \frac{j24X_C + j12X_C^2 + 10X_C^2}{(10 + j(12 - X_C))^2}$$

$$\underline{Z}_2 = \frac{(12X_C - j10X_C)\cdot(10 - j12 + jX_C)}{(10 + j(12 - X_C))^2}$$

$\mathrm{Im}(\underline{Z}) = 0$

$$\underline{Z}_2 = \frac{120X_C - j144X_C + j12X_C^2 - j100X_C - 120X_C + 10X_C^2}{(10 + j(12 - X_C))^2}$$

$$\frac{-24X_C + 12X_C^2}{100 + 144 - 24X_C + X_C^2} = -\frac{10}{1}$$

$$\underline{Z}_2 = \frac{-j24X_C + j12X_C^2 + 10X_C^2}{(10 + j(12 - X_C))^2}$$

$$-2440 + 240X_C - 10X_C^2 = -24X_C + 12X_C^2$$

$$-2440 + 240X_C - 10X_C^2 + 24X_C - 12X_C^2 = 0$$

$$-22X_C^2 + 484X_C - 2440 = 0$$

$$22X_C^2 - 484X_C + 2440 = 0$$

$$X_{C1,2} = \frac{484 \pm \sqrt{484^2 - 4\cdot 22\cdot 2440}}{44}$$

$X_{C1} = \boxed{14{,}18\ \Omega}$

$X_{C2} = \boxed{7{,}82\ \Omega}$