

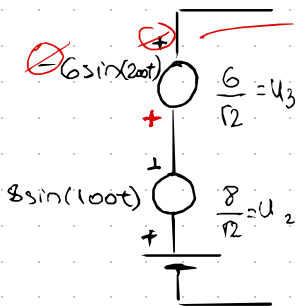
10. FREKVENCIIJSKA SUPERPOZICJA

LJIR 18/19.) (20.)

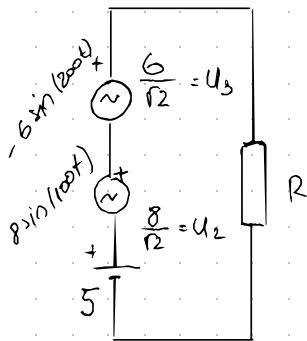
$$u(t) = \overset{(1)}{5} + \overset{(2)}{8\sin(100t)} - \overset{(3)}{6\sin(200t)}$$

$$\begin{aligned} u_{ef1} &= 5 \\ u_{ef2} &= \frac{8}{\sqrt{2}} \end{aligned}$$

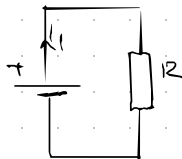
$$u_{ef3} = \frac{-6}{\sqrt{2}}$$



$$u_{ue} = \sqrt{u_1^2 + u_2^2 + u_3^2} = \underline{\underline{8,7\text{ V}}}$$

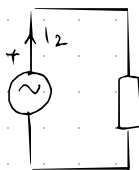


podijelimo na 3
spojke sa različitim izvorima



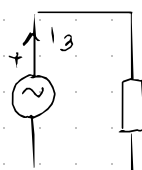
$$u_{ef1} = 5$$

$$i_1 = \frac{u_1}{R}$$



$$u_{ef2}$$

$$i_2 = \frac{u_2}{R}$$



$$u_{ef3}$$

$$i_3 = \frac{u_3}{R}$$

u efektivnoj superpoz: $i_1 + i_2 + i_3 = i_{ue}$

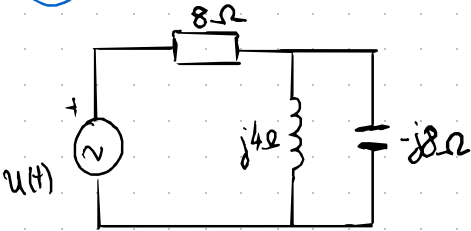
ali to ne vrijedi tu jer su
u različitoj frekvenciji

$$\underline{\underline{I_{ue} = \sqrt{i_1^2 + i_2^2 + i_3^2}}}$$

DOD 19/20.)

14) $u(t) = 16 + 32 \sin(\omega t) + 16 \sin(2\omega t)$

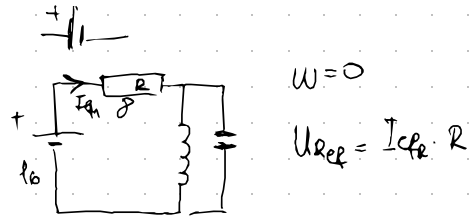
$U_{eff} = ?$



$X_L = j\omega L$

$X_C = \frac{1}{j\omega C} = -j\frac{1}{\omega C}$ $\omega=0 \rightarrow \infty$

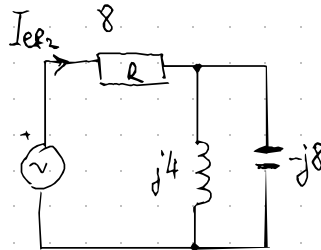
$\rightarrow \omega=0 \rightarrow 0$



$\omega=0$

$U_{eff} = I_{eff} \cdot R$

$I_{eff1} = \frac{16}{8} = \underline{\underline{2A}}$

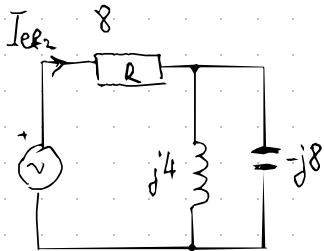


$I_{eff2} = \frac{U_{eff}}{Z}$

$Z = 8 + j8$

$I_{eff} = \frac{32}{\sqrt{2}} \cdot \frac{1}{8 + j8}$

$I_{eff2} = 2 \angle -45^\circ$



$\rightarrow X_{L2} = 2X_{L1} = 8j$

$\rightarrow X_{C2} = \frac{1}{2}X_{C1} = -4j$

$Z = 8 + j8$

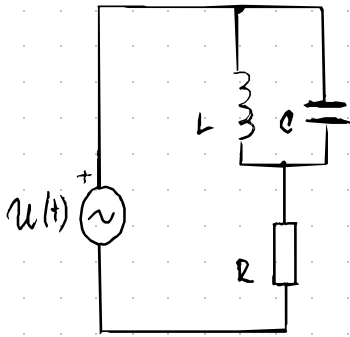
$I_{eff} = 1 \angle -45^\circ$

$I_{u2} = \sqrt{I_{eff1}^2 + I_{eff2}^2 + I_{eff3}^2}$

$I_{u2} = 3A$

JESEN 18./19.

2.



$$R = 12 \Omega$$

$$u(t) = 50 + 20\sqrt{2} \sin 500t + 10\sqrt{2} \sin 1000t$$

$$P = ?$$

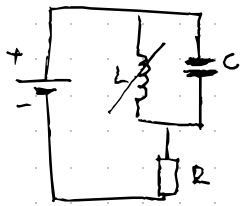
$$\omega = 500/\text{s}$$

$$X_L = 2 \Omega \quad X_C = 8 \Omega$$

$$P = I_{\text{eff}}^2 \cdot R$$

$$I_{\text{eff}} = \sqrt{I_{\text{eff}1}^2 + I_{\text{eff}2}^2 + I_{\text{eff}3}^2}$$

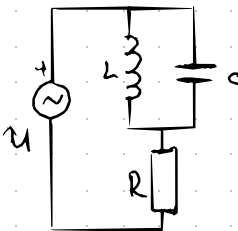
$$U_{\text{eff}1} = \frac{50}{\sqrt{2}} \text{ V}$$



$$X_L = \omega L \Rightarrow 0$$

$$X_C = \frac{1}{\omega C} \Rightarrow \infty$$

$$U_{\text{eff}2} = 20 \text{ V}$$



$$Z = 500 \cdot L$$

$$L = 4 \times 10^{-3} \text{ H}$$

$$\rho = \frac{1}{500 \cdot C}$$

$$C = 2,5 \times 10^{-4} \text{ F}$$

$$R = \frac{U}{I}$$

$$I = \frac{U}{R} = \frac{50}{12}$$

$$I_1 = 4,167$$

$$Z = \frac{U}{I}$$

$$Z_1 = \left(\frac{1}{jX_L} + \frac{1}{jX_C} \right)^{-1} = \frac{8}{3}j$$

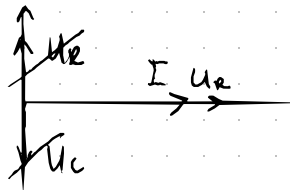
$$Z = Z_1 + R = \frac{8}{3}j + 12 = \frac{4\sqrt{85}}{3} \angle 12,53^\circ$$

$$I_2 = 1,63 \text{ A} \angle -12,53^\circ$$

$$U_{\text{eff}3} = 10 \text{ V}$$

$$X_L = 1000 \cdot 4 \times 10^{-3} = 4 \Omega$$

$$X_C = 4 \Omega$$



$$|CE| \quad |EL|$$

$$Z_{LC} = \left(\frac{1}{jX_L} + \frac{1}{jX_C} \right)^{-1} = \left(\frac{1}{j4} + \frac{1}{j4} \right)^{-1} = \left(\frac{-6j}{16} \right)^{-1}$$

prosti priključak ali ovisno o

$$\left(\frac{0}{16} \right)^{-1} = Z_{LC} = 0 \rightarrow I_3 = 0$$

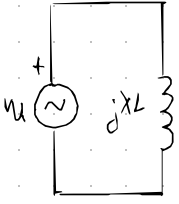
$$I_{\text{eff}} = \sqrt{I_1^2 + I_2^2 + 0} = 4,47 \text{ A}$$

$$P = 240,25 \text{ W}$$

21 20/21.)

9. $u(t) = 6 \sin(\omega t) + 3 \sin(\omega t)$

na freq ω ima induktivni otpor 3Ω . $I_{ef} = ?$



$$U_{ef1} = \frac{6}{\sqrt{2}} \quad \omega \rightarrow 3\Omega$$

$$U_{ef} = R \cdot I = 3 \cdot I$$

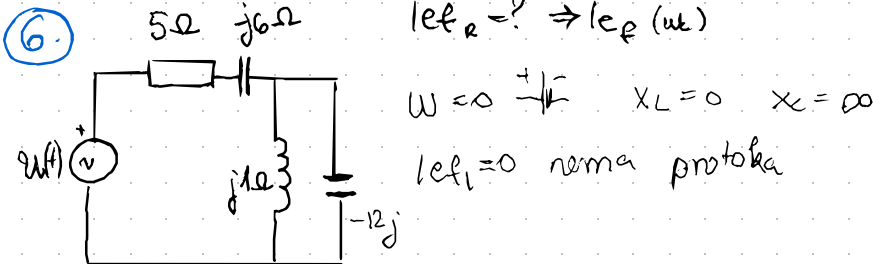
$$\frac{\frac{6}{\sqrt{2}} V}{j3\Omega} = I \rightarrow I = -\sqrt{2}i = \underline{1,41 \angle -90^\circ}$$

$$U_{ef2} = \frac{3}{\sqrt{2}} \quad \omega = 3\omega \rightarrow X_L = \omega L \rightarrow X_L = 3X_L$$

$$\Rightarrow 9\Omega$$

$$\frac{\frac{3}{\sqrt{2}} V}{j9\Omega} = I = \underline{0,24 \angle -90^\circ} \quad \boxed{I_{uk} = 1,43 A}$$

21 2021./22.) $u(t) = 150 + 5\sqrt{2} \sin(\omega t) + 2\sqrt{2} \sin(2\omega t) [V]$



$$I_{ef2} = ? \Rightarrow I_{ef}(u_k)$$

$$\omega = 0 \quad \frac{+}{-} \quad X_L = 0 \quad X_C = \infty$$

$$I_{ef1} = 0 \text{ nema protoka}$$

$$U_{ef2} = 5V \quad \omega \rightarrow X_{C1} = -j6\Omega \quad X_{C2} = -j12\Omega$$

$$X_L = j12\Omega$$

$$Z_1 = 5 - 6j$$

$$Z_2 = \left(\frac{1}{j} + \frac{1}{-12j} \right)^{-1} = \frac{12}{11} j \quad \left\{ \begin{array}{l} Z_1 + Z_2 = Z \Rightarrow 5 - 4,9j \\ Z = 7 \angle -44,5^\circ \end{array} \right.$$

$$I_{ef1} = \frac{U}{Z} = \frac{5}{7 \angle -44,5^\circ} = \underline{0,71 \angle 44,5^\circ}$$

$$U_{ef3} = 2V \quad 2\omega \rightarrow X_{C1} = -j3 \quad X_{C2} = -j6$$

$$X_L = j2$$

$$Z_1 = 5 - 3j$$

$$Z_2 = \left(\frac{1}{2j} + \frac{1}{-j6} \right)^{-1} = 3j \quad \left\{ \begin{array}{l} Z = R \text{ (rezonancija)} \rightarrow I = \frac{U}{R} = \frac{2}{5} \\ I = \underline{0,4 A} \end{array} \right.$$

$$I_{uk} = \sqrt{I_{ef1}^2 + I_{ef2}^2} = \boxed{0,81 A}$$