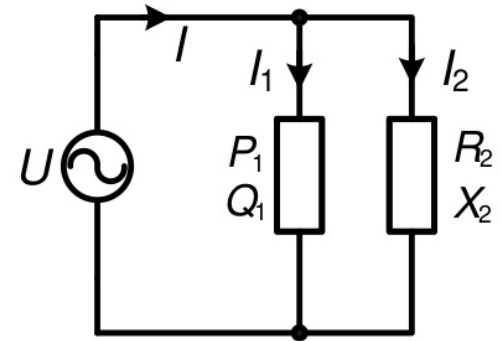


NAIZMENIČNE STRUJE deo 3

5. Dva prijemnika vezana su paralelno i priključena su na naizmenični napon efektivne vrednosti $U = 220V$, prema Slici 5. Aktivna snaga prvog prijemnika je $P_1 = 600W$, a reaktivna snaga $Q_1 = 450var$. Drugi prijemnik ima aktivnu otpornost $R_2 = 50\Omega$ i reaktivnu otpornost

$X_2 = -10\Omega$. Odrediti:

- prividnu snagu prvog prijemnika S_1 ;
- efektivne vrednosti struja I_1 i I_2 u prijemnicima;
- ukupnu aktivnu snagu P i ukupnu reaktivnu snagu Q ;
- efektivnu vrednost ukupne struje prijemnika I ;
- faktor snage ukupnog prijemnika $\cos(\varphi)$.



Slika 5

$$a) S_1 = \sqrt{P_1^2 + Q_1^2} = \sqrt{600^2 + 450^2} = \sqrt{4^2 \cdot 150^2 + 3^2 \cdot 150^2} = 150 \sqrt{16 + 9} = 150 \cdot 5 = 750VA$$

$$600 = 2 \cdot 3 \cdot 2 \cdot 5 \cdot 2 \cdot 5 = 2^3 \cdot 3 \cdot 5^2 = 4 \cdot (2 \cdot 3 \cdot 5^2) = 4 \cdot 150$$

$$450 = 9 \cdot 5 \cdot 10 = 3^2 \cdot 5 \cdot 2 \cdot 5 = 2 \cdot 3^2 \cdot 5^2 = 3 \cdot (2 \cdot 3 \cdot 5^2) = 3 \cdot 150$$

$$b) S_1 = UI_1 \Rightarrow I_1 = \frac{S_1}{U} = \frac{750}{220} = 3,14 A$$

$$Z_2 = \sqrt{R_2^2 + X_2^2} = \sqrt{50^2 + (-10)^2} = \sqrt{5^2 \cdot 10^2 + 10^2} = 10 \sqrt{26} = 50,99 \Omega$$

$$U = Z_2 I_2 \Rightarrow I_2 = \frac{U}{Z_2} = \frac{220}{50,99} = 4,3A$$

$$c) P_2 = R_2 I_2^2 = 925 \text{ W}$$

$$Q_2 = X_2 I_2^2 = -185 \text{ var} \Rightarrow$$

$$P = P_1 + P_2 = 1525 \text{ W}$$

$$Q = Q_1 + Q_2 = 265 \text{ var} > 0 \Rightarrow \text{INDUKTIVNI POTROŠAČ}$$

$$d) I = \cancel{I_1} + I_2$$

$$S = \sqrt{P^2 + Q^2} = \sqrt{1525^2 + 265^2} = 5 \sqrt{305^2 + 53^2} = 1547,9 \text{ VA}$$

$$S = U \cdot I \Rightarrow I = \frac{S}{U} = 7,03 \text{ A}$$

$$\begin{array}{r|l} 1525 & 5 \\ 305 & 5 \\ 61 & \end{array} \quad \begin{array}{r|l} 265 & 5 \\ 53 & \end{array}$$

$$e) P = S \cos \varphi \Rightarrow \cos \varphi = \frac{P}{S} = 0,985$$

$$(R = Z \cos \varphi)$$

PROBATI ZA DOMAĆI:

$$R_1 = P_1 / I_1^2$$

$$\bar{z}_1 = R_1 + jX_1$$

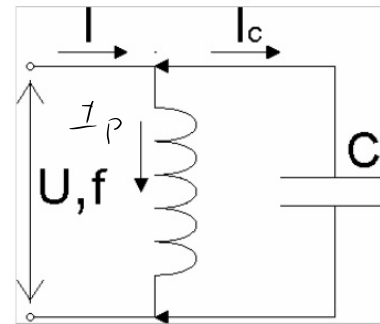
$$X_1 = Q_1 / I_1^2$$

$$\bar{z}_2 = R_2 + jX_2$$

$$\Rightarrow \bar{z} = \frac{\bar{z}_1 \cdot \bar{z}_2}{\bar{z}_1 + \bar{z}_2} = \dots = R + jX \Rightarrow \cos \varphi = \frac{R}{z} = \dots ?$$

$$Q > 0$$

10. Jedan induktivni prijemnik priključen je na naizmenični napon efektivne vrednosti $U = 220V$ i učestanosti $f = 50Hz$. Efektivna vrednost struje prijemnika je poznata i iznosi $20A$, dok mu je aktivna snaga $2kW$. Odrediti kapacitet kondenzatora koji treba priključiti paralelno prijemniku (Slika 7) da bi se dobio faktor snage 0.9 .



Slika 7

$$U = 230V \quad f = 50Hz \quad I_p = 20A \quad P = 2kW$$

$$S = UI_p = 230 \cdot 20 = 4600 VA$$

W INDUKTIVNI $Q > 0$

$$Q = \pm \sqrt{S^2 - P^2} = + \sqrt{4600^2 - 2000^2} = \sqrt{(23 \cdot 200)^2 - (10 \cdot 200)^2} = 200 \sqrt{23^2 - 10^2} = 200 \sqrt{529 - 100}$$

X KAPACITIVNI $Q < 0$

$$Q = 200 \sqrt{429} = 4142,5 VAR > 0 \text{ INDUKTIVNI POTROŠAČ}$$

$$\cos \varphi = \frac{P}{S} = \frac{2000}{4600} = \frac{10}{23} = 0,43$$

POPRAVKA:

$$C \Rightarrow \bar{Z}_c = -j \frac{1}{\omega C} \Rightarrow \bar{S}_c = \bar{Z}_c I_c^2 = U \bar{I}_c^* = \frac{U^2}{\bar{Z}_c^*} = U^2 \bar{Y}_c^* = -j \omega f C U^2$$

$$\bar{Y}_c = j \omega f C \quad P_c = 0 \quad Q_c = -2 \omega f C U^2$$

$$P_{UK} = P + P_C = 2 \text{ kW}$$

$$Q_{UK} = Q + Q_C$$

← ovo bi idealno bilo = 0 ako je $\cos \varphi_{UK} = 1$, ali u našem slučaju je:

$$(Q = 4142,5 \text{ VAR} > 0)$$

~~$S_{UK} = S + S_C$~~ PAZI! (MOŽE: $\overline{S}_{UK} = \overline{S} + \overline{S}_C$)

$$\cos \varphi_{UK} = \frac{P_{UK}}{S_{UK}} \Rightarrow S_{UK} = \frac{P_{UK}}{\cos \varphi_{UK}} = \frac{2000}{0,9} = 2222,22$$

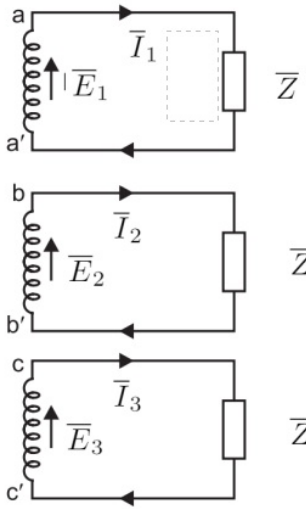
DAKLE $Q_{UK} \neq 0$; SEDNAMA JE:

$$Q_{UK} = \left(\frac{+}{-} \right) \sqrt{S_{UK}^2 - P_{UK}^2} = + \sqrt{2222,22^2 - 2000^2} = \sqrt{938261,73} = 968,64 \text{ VAR}$$

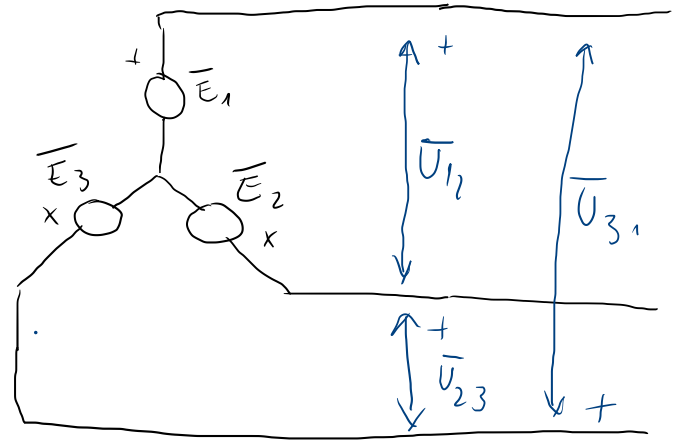
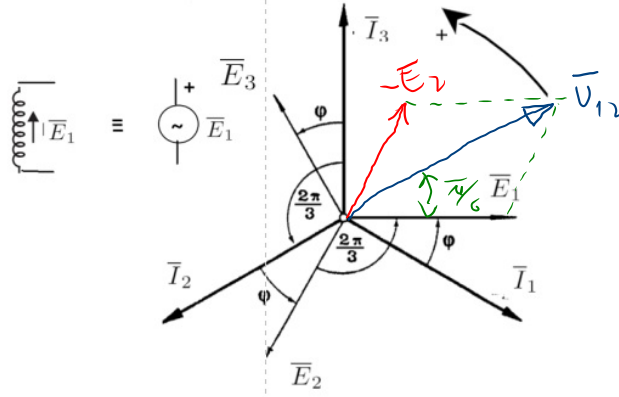
moćno je i + i - tj. POSTOJE 2 REŠENJA. ALI UVEK SE BIRA + JER JE POTROŠIO BILU INDUKTIVNI PAĆE SE DOBITI MANJE C.

$$Q_C = Q_{UK} - Q = 968,64 - 4142,5 = -3173,8 \text{ VAR} < 0 \text{ (KONDENZATOR)}$$

$$Q_C = -\omega^2 C U^2 \Rightarrow C = \frac{-Q_C}{\omega^2 U^2} = \frac{3173,8}{2 \cdot 3,14 \cdot 50 \cdot 230^2} = 191 \mu\text{F}$$



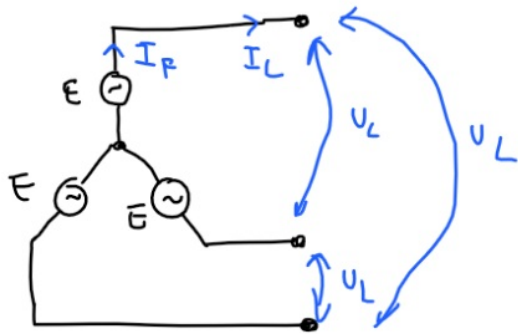
$$\begin{aligned} \bar{E}_1 &= E e^{j0} & \bar{I}_1 &= I e^{-j\varphi} \\ \bar{E}_2 &= E e^{-j\frac{2\pi}{3}} & \bar{I}_2 &= I e^{-j\frac{2\pi}{3} - j\varphi} \\ \bar{E}_3 &= E e^{j\frac{2\pi}{3}} & \bar{I}_3 &= I e^{j\frac{2\pi}{3} - j\varphi} \end{aligned}$$



$$\bar{U}_{12} = \bar{E}_1 - \bar{E}_2 = E - E e^{-j\frac{2\pi}{3}} = E + E e^{j\pi} e^{-j\frac{2\pi}{3}} = E + E e^{j\frac{\pi}{3}} = E e^{j\pi/6} (e^{-j\pi/6} + e^{j\pi/6})$$

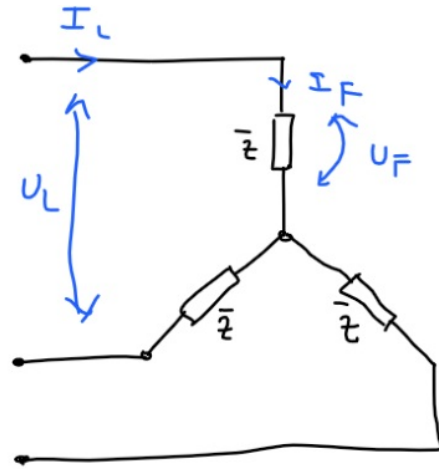
$$\bar{U}_{12} = E e^{j\pi/6} \cdot \underbrace{2 \cos \frac{\pi}{6}}_{\sqrt{3}/2} = \sqrt{3} E e^{j\pi/6} \Rightarrow |\bar{U}_{12}| = E\sqrt{3}$$

$$\text{ISTO JE I TA } (|\bar{U}_{23}| = |\bar{U}_{31}| = |\bar{U}_{12}| = E\sqrt{3})$$



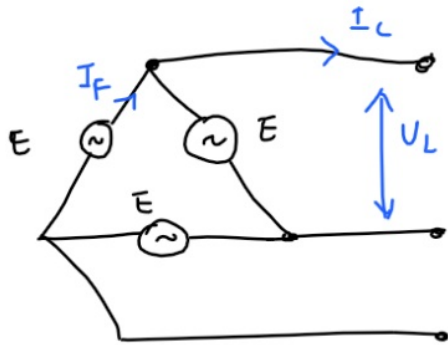
$$I_F = I_L$$

$$U_L = E\sqrt{3}$$



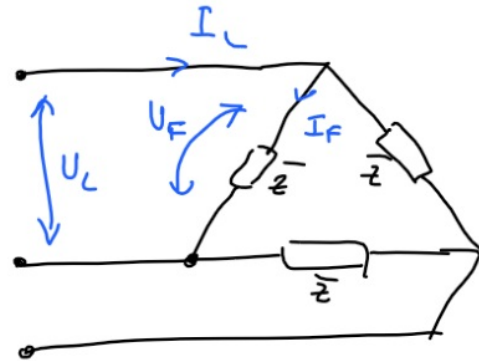
$$U_F = \frac{U_L}{\sqrt{3}}$$

$$I_F = I_L$$



$$U_L = E$$

$$I_L = I_F\sqrt{3}$$



$$U_F = U_L$$

$$I_F = \frac{I_L}{\sqrt{3}}$$

SNAGA :

$$S = 3 U_F I_F = \sqrt{3} U_L I_L$$

$$P = S \cos \varphi$$

$$Q = S \sin \varphi$$

$$3 \times \bar{z} ; \bar{z} = R + jX$$

$$\cos \varphi = \frac{P}{S} = \frac{R}{z}$$