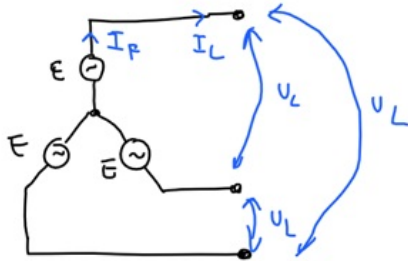


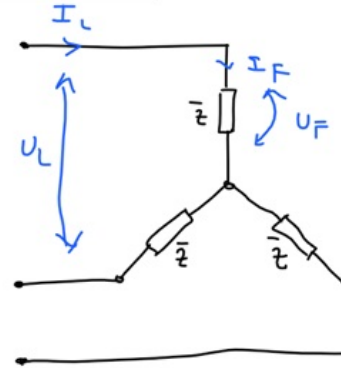
# NAIZMENIČNE STRUJE

## TROFAZNI SISTEMI



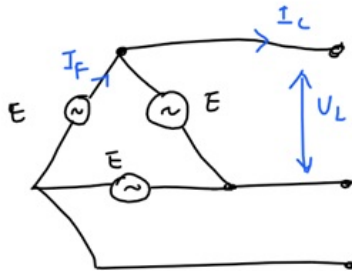
$$I_F = I_L$$

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



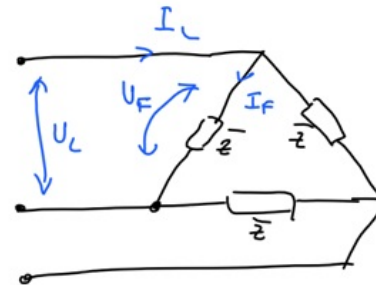
$$U_F = \frac{U_L}{\sqrt{3}}$$

$$I_F = I_L$$



$$U_L = E$$

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



$$U_F = U_L$$

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

SNAGA :

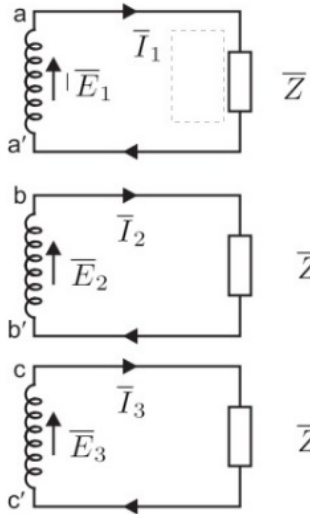
$$S = 3 U_F I_F = \sqrt{3} U_L I_L$$

$$P = S \cos \varphi$$

$$Q = S \sin \varphi$$

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

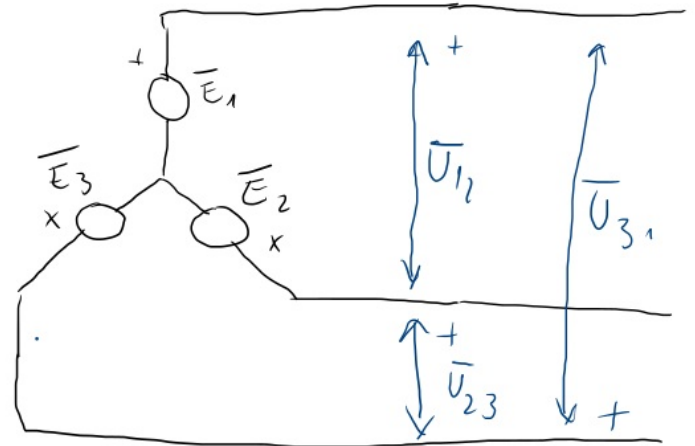
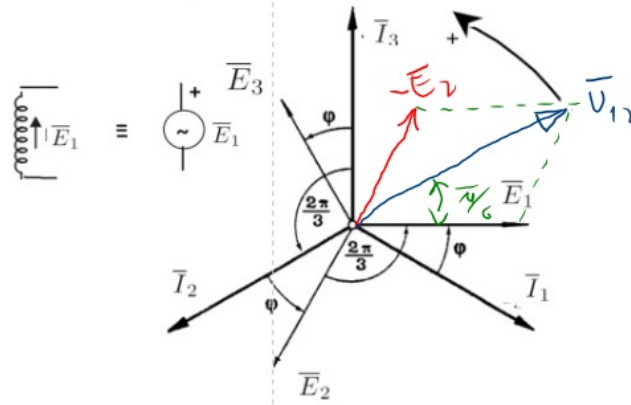
$$\cos \varphi = \frac{P}{S} = \frac{R}{z}$$



$$\bar{E}_1 = Ee^{j0} \quad \bar{I}_1 = Ie^{-j\varphi}$$

$$\bar{E}_2 = Ee^{-j\frac{2\pi}{3}} \quad \bar{I}_2 = Ie^{-j\frac{2\pi}{3}-j\varphi}$$

$$\bar{E}_3 = Ee^{j\frac{2\pi}{3}} \quad \bar{I}_3 = Ie^{j\frac{2\pi}{3}-j\varphi}$$



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

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

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

1. Na trofazni sistem napona  $3 \times 400 \text{ V}$  priključen je trofazni potrošač, povezan u trougao. Kompleksna impedansa svake faze iznosi  $\bar{Z} = 20 - j20 \Omega$ . Odrediti efektivnu vrednost faznih struja i aktivnu snagu potrošača.

GENERATOR:

$3 \times 400 \text{ V} \Rightarrow$  3-FAZNI SISTEM

LINIJSKI NAPON  $U_L = 400 \text{ V}$

POTROŠAČ: VEŽA U  $\Delta$  (slika)

$$\Rightarrow U_F = U_L = 400 \text{ V}$$

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

OMOV ZAKON NA POTROŠAČU:

$$U_F = Z_F I_F$$

$$Z = \sqrt{20^2 + (-20)^2} = 20\sqrt{2} \Omega$$

$$I_F = \frac{U_F}{Z} = \frac{400}{20\sqrt{2}} = \frac{20}{\sqrt{2}} = 10\sqrt{2} \text{ A}$$

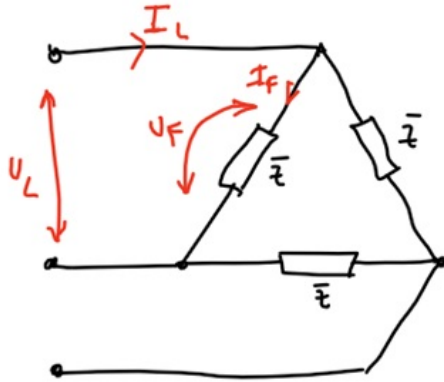
$$I_L = \sqrt{3} I_F = 10\sqrt{6} \text{ A}$$

SNAGA:

$$P = 3 R_0 I_F^2 = 3 \cdot 20 \cdot (20\sqrt{2})^2 = 42 \text{ kW}$$

$$Q = 3 X \cdot I_F^2 = 3 \cdot (-20) \cdot (20\sqrt{2})^2 = -42 \text{ kVAR}$$

$$S = 3 Z I_F^2 = 3 \cdot 20\sqrt{2} \cdot (20\sqrt{2})^2 = 42\sqrt{2} \text{ kVA}$$



SNAGA ALTERNATIVE:

$$S = 3Z I_F^2 = 3U_F I_F = 3 \frac{U_F^2}{Z} = \sqrt{P^2 + Q^2}$$

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

$$\sin \varphi = \frac{Q}{S} = \frac{X}{Z}$$

$$P = 3R I_F^2 = S \cos \varphi$$

$$Q = 3X \cdot I_F^2 = S \sin \varphi$$

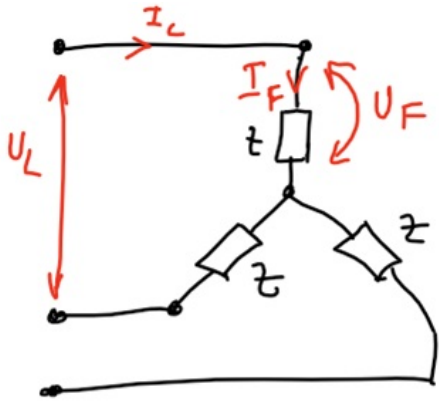
POTREBNO JE ZNATI SVE OBRASCE I  
KORISTITI NAJPOGODNIJE!

2. Na trofazni sistem napona  $3 \times 400 \text{ V}$  priključen je simetrični trofazni potrošač, povezan u zvezdu. Poznato je da ukupna aktivna snaga potrošača iznosi  $8 \text{ kW}$ , dok ukupna reaktivna snaga potrošača iznosi  $6 \text{ kvar}$ . Odrediti:

- efektivnu vrednost linijskih i faznih struja i napona potrošača,
- faktor snage potrošača,
- vrednost kompleksna impedanse koja je povezana u svaku od faza trofaznog sistema.

GENERATOR :  $3 \times 400 \text{ V} \Rightarrow U_L = 400 \text{ V}$

POTROŠAČ : VEŽA u  $\Delta \Rightarrow I_L = I_F$   
(slika)  $U_L = \sqrt{3} U_F$



a)

$$U_F = \frac{U_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230,94 \text{ V}$$

$$S = \sqrt{P^2 + Q^2} = \sqrt{(8000)^2 + (6000)^2} = 2000 \sqrt{4^2 + 3^2} = 10 \text{ kVA}$$

$$S = 3U_F I_F \Rightarrow I_F = \frac{S}{3U_F} = \frac{10000}{3 \cdot \frac{400}{\sqrt{3}}} = \frac{25}{\sqrt{3}} \text{ A} = 14,53 \text{ A}$$

$$I_L = I_F = 14,53 \text{ A}$$

$$b) \cos \varphi = \frac{P}{S} = \frac{8 \text{ k}}{10 \text{ k}} = 0,8$$

$$c) \sin \varphi = \frac{Q}{S} = \frac{6 \text{ k}}{10 \text{ k}} = 0,6$$

$$\bar{Z} = Z e^{j\varphi} = \underbrace{Z \cos \varphi}_R + j \underbrace{Z \sin \varphi}_X \Rightarrow$$

$$Z = \frac{U_F}{I_F} = \frac{400/\sqrt{3}}{25/\sqrt{3}} = 16 \Omega$$

$$R = Z \cos \varphi = 16 \cdot 0,8 = 12,8 \Omega$$

$$X = Z \sin \varphi = 16 \cdot 0,6 = 9,6 \Omega$$

$$\bar{Z} = 12,8 + j 9,6 \Omega$$

ALTERNATIVNO

$$R = \frac{P}{3I_F^2} = \dots$$

$$X = \frac{Q}{3I_F^2} = \dots$$