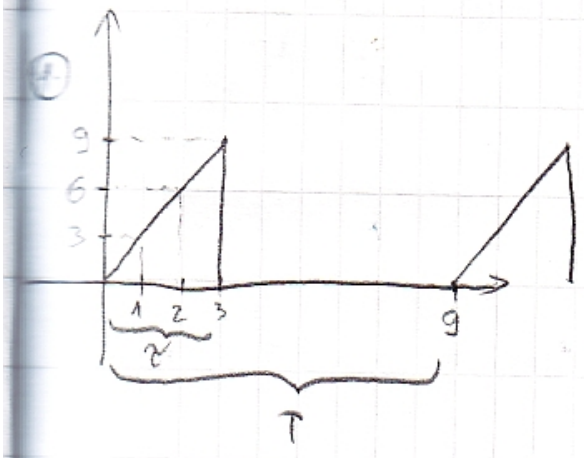
Hoss - OE 26.01.2099

1.



faktor oblika $\Rightarrow \frac{U_{ef}}{U_{sr}} =$

$$U_{sr} = \frac{1}{T}\int_0^{\tau} u(t)\,dt = \frac{1}{9}\int_0^{3} 3t\,dt$$

$$U_{ef} = \sqrt{\frac{1}{T}\int_0^{\tau} u^2(t)\,dt}$$

$u(t) = 3t$

$i(t) = I_0 + I_{m1}\cos(\omega_1 t) + I_{m2}\cos(\omega_2 t) + \dots$

$$I_{ef} = \sqrt{I_0^2 + \left(\frac{I_{1m}}{\sqrt{2}}\right)^2 + \left(\frac{I_{m2}}{\sqrt{2}}\right)^2 + \dots}$$

$i(t) = I_0 + 3\cos(2t) + 7\sin(3t+30°)$

$R = 3\,\Omega$

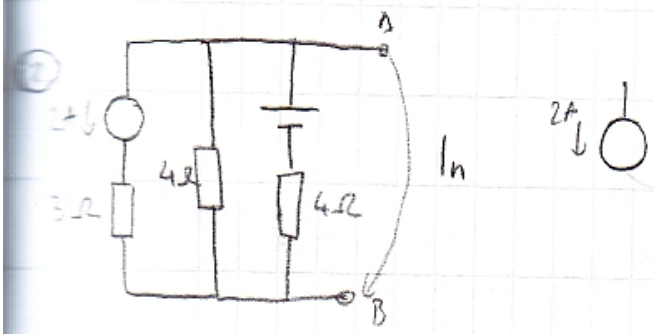
$P = 127\,W$

$$I_{ef} = \sqrt{I_0^2 + \left(\frac{3}{\sqrt{2}}\right)^2 + \left(\frac{7}{\sqrt{2}}\right)^2}$$

$P = I_{ef} \cdot R = \dots$

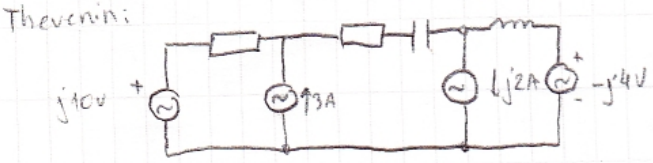
SUPERPOZICIJA

2.



Izmjenični krugovi - izbjegavati više jednadžbi za više nepoznanica (čak i 2)

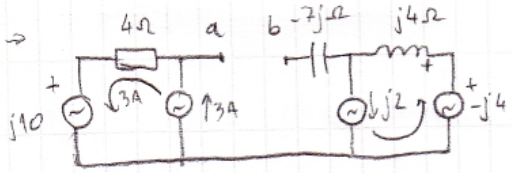
Thevenin:



a) Z = impedancija

b) Z = otpor

Max snaga?



$U_{ab} = ?$

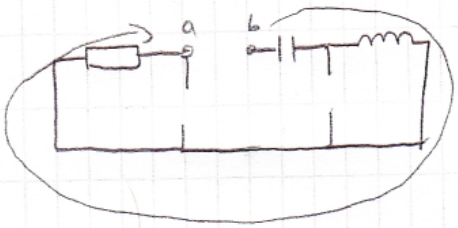
$U_{ab} = j4 \cdot j2 - (-j4) + j10 + 4 \cdot 3$

$U_{ab} = -8 + j14 + 12$

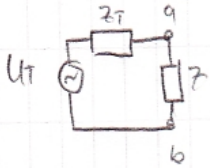
$= 4 + j14\ V$

$U_T = |U_{ab}| = \sqrt{14^2 + 4^2} = 14{,}56\ V$

$R_T \rightarrow$ (gasimo izvore) $\rightarrow$



$Z_T = 4 + j4 - j7 = 4 - j3\ \Omega$



a) za $P_{max} \rightarrow Z = (Z_T)^* = 4 + j3$

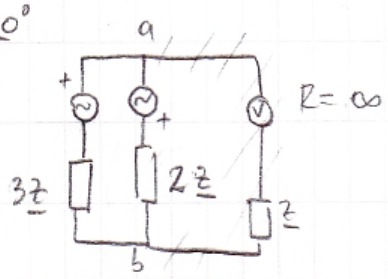
$I = \frac{U}{Z + Z_T} = \frac{14{,}56}{8}$

$P = I^2 \cdot Re\{Z\} = \ldots$

b) $R = |Z_T| \Rightarrow R = 5\ \Omega$

{postupak isti} $\rightarrow P = I^2 R$

2. $U = 10\angle 0°$



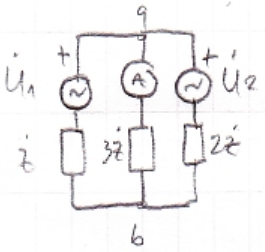
$U_{ab} = ?$

Millmanov $\Rightarrow U_{ab} = \dfrac{\frac{U_1}{3Z} - \frac{U_2}{2Z}}{\frac{1}{3Z} + \frac{1}{2Z}}$

$= \dfrac{2U_1 - 3U_2}{5}$

$U_V = |U_{ab}| = \dots$

3.



$U_1 = U_2 = 10j\ V$

$I_a = 2\ A$

$U_{ab} = \{\text{Mleman}\} = \dfrac{\frac{U_1}{Z} + \frac{U_2}{2Z}}{\frac{1}{Z} + \frac{1}{2Z} + \frac{1}{3Z}} = \dfrac{\frac{30j}{2Z}}{\frac{11}{6Z}} = \dfrac{90}{11}j\ V$

$3Z = \dfrac{\left|\frac{90j}{11}\right|}{2} \rightarrow Z = \dfrac{15}{11}$

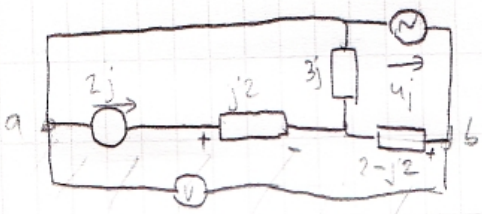
Polaritet: $\rightarrow$ mijenja se predznak U_1

$U_{ab} = \dfrac{-\frac{U_1}{Z} + \frac{U_2}{2Z}}{\frac{1}{Z} + \frac{1}{2Z} + \frac{1}{3Z}} \Rightarrow U_{ab} = \dfrac{\frac{-10}{2Z}}{\frac{11}{6Z}} = \dfrac{-30j}{11}$

$I_a' = \dfrac{|U_{ab}|}{|3Z|} = \dfrac{\frac{30}{11}}{\frac{45}{11}} = \dfrac{2}{3}\ A$

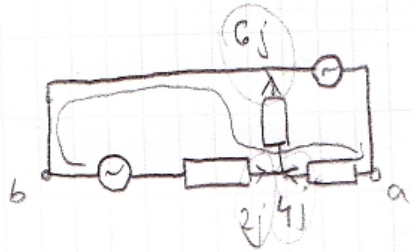
Tywin bi ovaj zad želio, baš mu je simpatičan =)

3.



$U_V = ?$

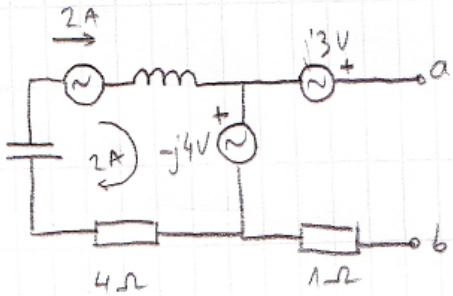
$U_V = |U_{AB}|$ | Tražimo U_{AB} → idemo od B → A !!



Ne idemo preko strujnog izvora jer ne znamo napon

$$U_V = |U_{AB}| = |3j \cdot 6j + 4j(2-j2)|$$

4.



$U_T, R_T = ?$

$U_T = U_{AB}$

$U_{AB} = -j4 - j3 = -j7\,V$

$= 1\angle -90\,V$

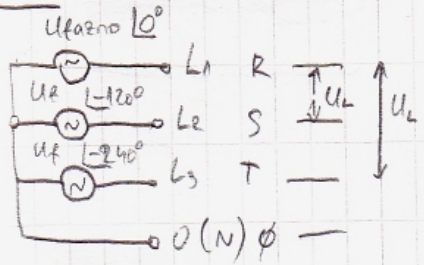
$R_T = 1\,\Omega$

Trofazni sustavi - strana izvora i strana trošila

- zvijezda i trokut

- simetrični i nesimetrični

IZVOR



$U_L = \sqrt{3} U_f$

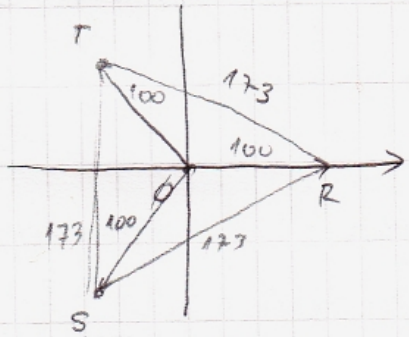
Uvijek odrediti jer se prelaci u stranu trošila

Fazni napon

Linijski napon – napon između 2 linije

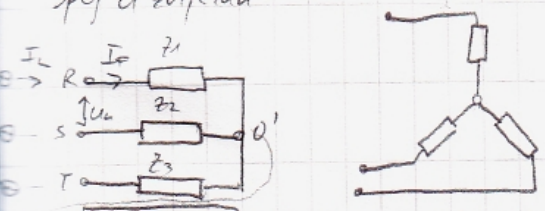
TOPOGRAFSKI DIJAGRAM

100/173



SIMETRIČNO TROŠILO

Spoj u zvijezdu Y



$Z_1 = Z_2 = Z_3$ → Trošilo je simetrično (nul-vod je nepotreban)

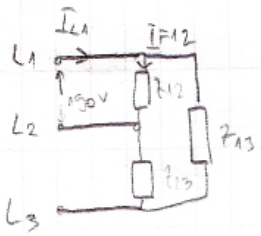
$I_0 = 0$

Snaga → 3. P_1 grane

$$P_1 = Re\{\dot{U} \cdot I^*\}$$

$$= U \cdot I \cdot \cos\varphi = \frac{U^2}{Z} \cos\varphi = I^2 \cdot \underbrace{Z \cdot \cos\varphi}_{Re\{Z\}}$$

Trokut △



Izvor $U = 110\ V$ $\quad Z_{12} = Z_{13} = Z_{23} = 60 - j80\ \Omega$

$P_{uk} = ?$ $\quad Z = 100\ \angle -53,13°$

$U_L = 110 \cdot \sqrt{3} = 190\ V$

$\boxed{U_F = U_L}$

$I_F = \frac{190}{100} = 1,9\ A$

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

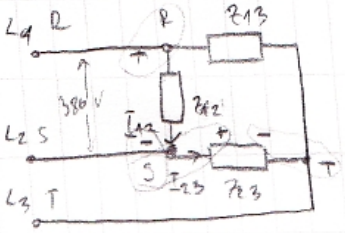
$P = I^2 \cdot Re\{Z\} = 1,9^2 \cdot 60$

$P_{uk} = 3 \cdot P$

Ø dodatelka, Ø okusa

NESIMETRIČNA TROŠILA - SPOJ U TROKUT (LAKŠE)

- SPOJ MITRAD NEMA NUL-VOD



$Z_{12} = 30\angle 0°\ \Omega$

$Z_{23} = 100\angle 45°\ \Omega$

$Z_{13} = 100\angle 36,87°\ \Omega$

R → S → T

$U_R = 220\angle 30°$

↓

$U_S = 220\angle -90$

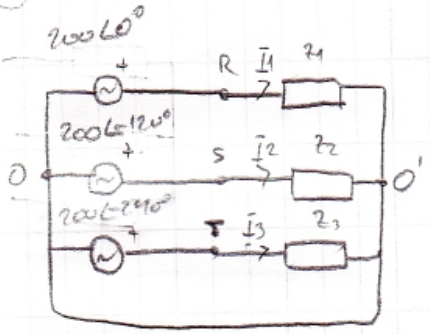
$U_T = 220\angle -150$

$$\dot{I}_{12} = \frac{\dot{U}_R - \dot{U}_S}{\dot{Z}_{12}}$$

$$\dot{I}_{23} = \frac{\dot{U}_S - \dot{U}_T}{\dot{Z}_{23}}$$

$\dot{I}_{L2} = \dot{I}_{23} - \dot{I}_{12}$ {Po kirchoffu}

$P_{uk} = P_{12} + P_{23} + P_{31}$

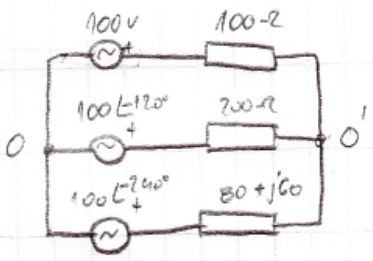


R→S→T

$U_f = 200V$

$\dot{I}_1 + \dot{I}_2 + \dot{I}_3 = \dot{I}_0$

TESIMETRONO TROJILO bez nul voda

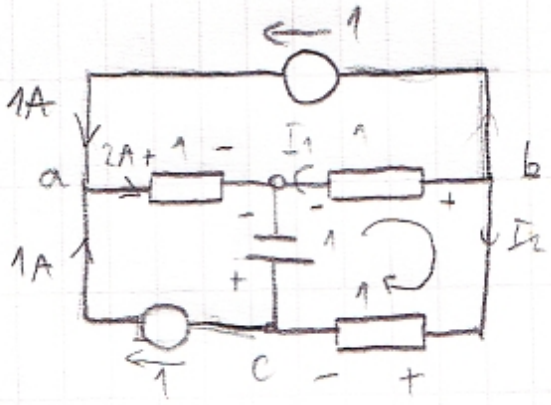


$$U_{0'0} = \frac{\frac{100}{100} + \frac{100\angle -120^\circ}{200} + \frac{100\angle -240}{80+j60}}{\frac{1}{100} + \frac{1}{200} + \frac{1}{80+j60}}$$

Ako napon raste od O'O za reći ćemo, mora rasti u svim granama za isti iznos

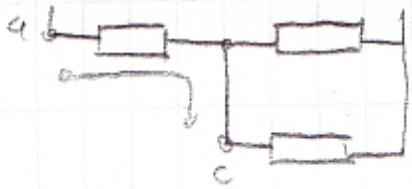
$$U_{0'0} = 100\angle -120^\circ - I_{F2} \cdot 200$$

VJEŽBE



a) $U_{ac} = ? = -1 + 2 = 1V$

$R_{ac} = ?$ (ugasit izvore) $= 1\Omega$



b) nadomjesni parametri za U_{BC} i R_{BC}

2 KZN: $-1 + I_1 \cdot 1 - I_2 \cdot 1 = 0$

$I_1 + I_2 + 1 = 0$

$I_1 - I_2 = 0$

$I_1 + I_2 = -1$

$I_1 = 0$

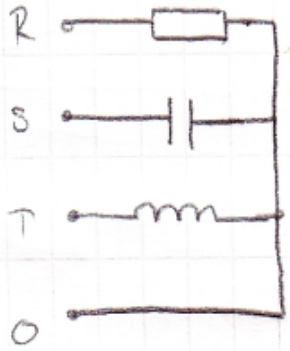
$I_2 = -1$

$U_{BC} = -I_2 \cdot 1$

$U_{BC} = 1V$

$R_{BC} = 1 \| 1 = 0{,}5\Omega$

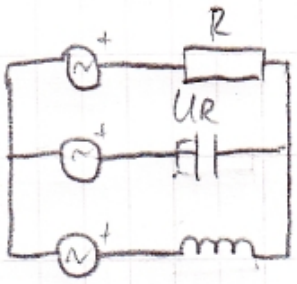
$I_n = \frac{U_{ab}}{R_{ab}}$



$P_{uk} = 20W = P_{uk} = P_R$

$R = X_L = X_C$

$P = I^2 \cdot R = \frac{U^2}{Z} \cos\varphi = \frac{U_f^2}{R} = 20W$



$P' = \frac{U_R^2}{R}$

$$U_{oo'} = \frac{\frac{U_f \angle 0°}{R} + \frac{U_f \angle -120°}{-Rj} + \frac{U_f \angle -240°}{j'R}}{\frac{1}{R} + \frac{1}{jR} - \frac{1}{jR}}$$

$W = \frac{QU}{2} = \frac{Q^2}{2C} = \frac{U^2 C}{2}$ $\quad C = \varepsilon \cdot \frac{S}{d}$ $\quad$ Paralelni, serijski spoj ⊣⊢

$U_L = -L \cdot \frac{\Delta i}{\Delta t}$

Raspodjela naboja, polje