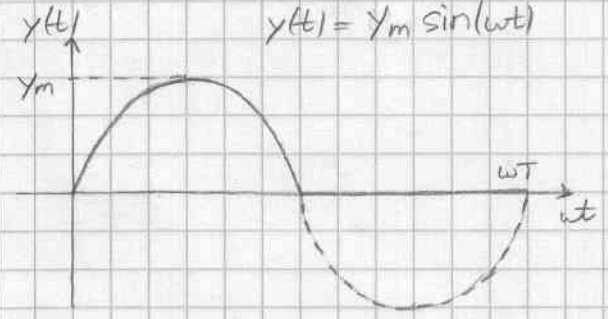
FORMULE:

$$Y_{ef} = \sqrt{\frac{1}{T}\int_0^T |y(t)|^2\,dt} \qquad Y_{sr} = \frac{1}{T}\int_0^T y(t)\,dt$$

$$\xi = \frac{Y_{ef}}{Y_{sr}}, \quad \sigma = \frac{Y_m}{Y_{ef}} - \text{TEMENI FAKTOR}$$

$$Y_{ef} = \sqrt{Y_0^2 + Y_{1ef}^2 + Y_{2ef}^2 + \dots}$$

- POLUVALNO ISPRAVLJENI SINUSNI SIGNAL



$y(t) = Y_m \sin(\omega t)$

- $Y_{sr} = \frac{1}{2\pi}\int_0^{\pi} Y_m \sin(\omega t)\,d(\omega t)$

$= \frac{1}{2\pi} Y_m (-1) \cos(\omega t)\Big|_0^{\pi}$

$= \frac{Y_m}{\pi}$

- $Y_{ef} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} (Y_m \sin(\omega t))^2\,d(\omega t)}$

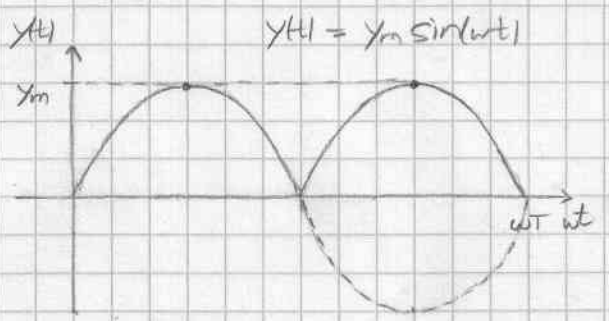
$= Y_m \sqrt{\frac{1}{2\pi}\int_0^{\pi} \sin^2(\omega t)\,d(\omega t)}$

$= Y_m \sqrt{\frac{1}{2\pi}\int_0^{\pi} \frac{1}{2}(1-\cos(\omega t))\,d(\omega t)}$

$= Y_m \sqrt{\frac{1}{2\cdot 2\pi}\cdot(\omega t - \sin(\omega t))\Big|_0^{\pi}}$

$= \frac{Y_m}{2}$

- PUNOVALNO ISPRAVLJENI SINUSNI SIGNAL



$y(t) = Y_m \sin(\omega t)$

- $Y_{sr} = \frac{1}{\pi}\int_0^{\pi} Y_m \sin(\omega t)\,d(\omega t)$

$= \frac{1}{\pi} Y_m (-1) \cos(\omega t)\Big|_0^{\pi}$

$= \frac{2Y_m}{\pi}$

- $Y_{ef} = \sqrt{\frac{1}{\pi}\int_0^{\pi} (Y_m \sin(\omega t))^2\,d(\omega t)}$

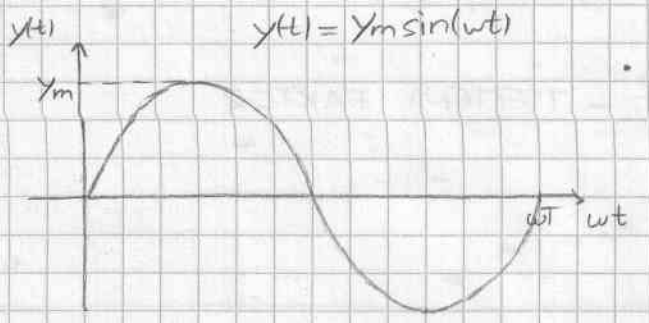
$= Y_m \sqrt{\frac{1}{\pi}\int_0^{\pi} \sin^2(\omega t)\,d(\omega t)}$

$= Y_m \sqrt{\frac{1}{\pi}\cdot\frac{1}{2}\int_0^{\pi} (1-\cos(\omega t))\,d(\omega t)}$

$= Y_m \sqrt{\frac{1}{2\pi}(\omega t - \sin(\omega t))\Big|_0^{\pi}}$

$= Y_m \sqrt{\frac{1}{2\pi}\cdot\pi} = \frac{Y_m}{\sqrt{2}}$

- SINUSNI SIGNAL



$y(t) = Y_m \sin(\omega t)$

- $Y_{sr} = \frac{1}{2\pi} \int_0^{2\pi} Y_m \sin(\omega t)\, d(\omega t)$

$= \frac{1}{2\pi} Y_m (-1) \cos(\omega t) \Big|_0^{2\pi}$

$= 0$

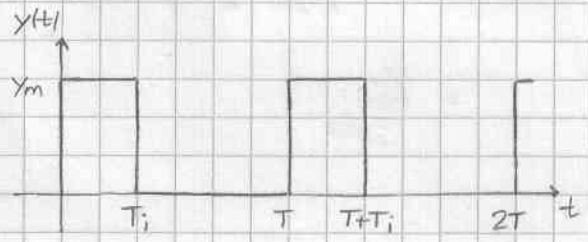
- $Y_{ef} = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} (Y_m \sin(\omega t))^2 d(\omega t)}$

$= Y_m \sqrt{\frac{1}{2\pi} \int_0^{2\pi} \sin^2(\omega t)\, d(\omega t)}$

$= Y_m \sqrt{\frac{1}{2\pi} \frac{1}{2} \int_0^{2\pi} (1 - \cos(\omega t))\, d(\omega t)}$

$= Y_m \sqrt{\frac{1}{4\pi} (\omega t - \sin(\omega t)) \Big|_0^{2\pi}} = \frac{Y_m}{\sqrt{2}}$

- PRAVOKUTNI SIGNAL



T_i - TRAJANJE IMPULSA

- $Y_{sr} = \frac{1}{T} \int_0^{T_i} Y_m\, dt$

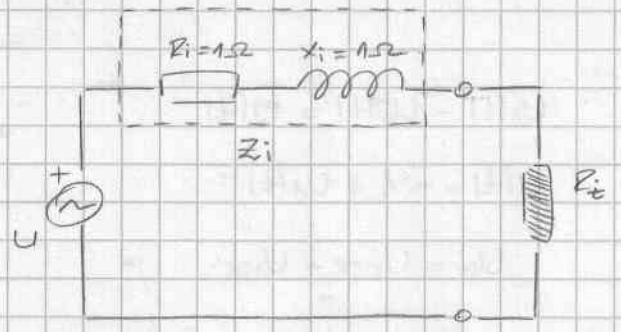
$= Y_m \frac{1}{T} \cdot t \Big|_0^{T_i}$

$= Y_m \frac{T_i}{T}$

- $Y_{ef} = \sqrt{\frac{1}{T} \int_0^{T_i} (Y_m)^2\, dt}$

$= Y_m \sqrt{\frac{1}{T} \int_0^{T_i} dt}$

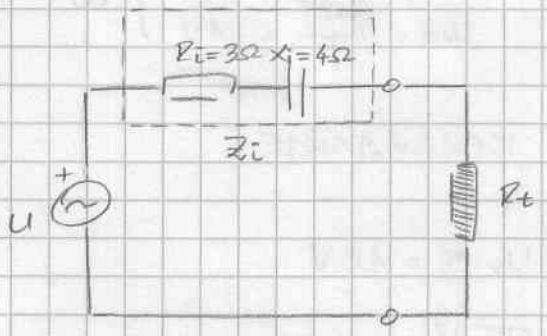
$= Y_m \sqrt{\frac{1}{T} \cdot t \Big|_0^{T_i}} = Y_m \sqrt{\frac{T_i}{T}}$

① 

UVJET MAX. SNAGE:

$R_t = |Z_t|$

$R_t = \sqrt{1^2+1^2} = \sqrt{2}\,\Omega$

② 

UVJET MAX. SNAGE:

$R_t = |Z_i|$

$R_t = \sqrt{3^2+4^2} = 5\,\Omega$

$R_t \in \langle 0,5 \rangle$ - SNAGA RASTE

$R_t \in \langle 5,\infty \rangle$ - SNAGA PADA

③ 

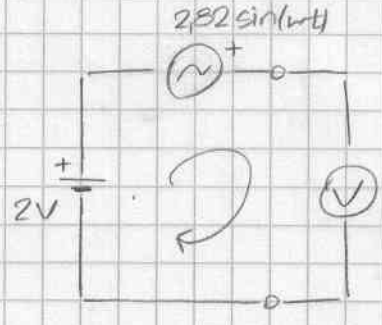
$\varphi = -120^\circ = -\frac{2\pi}{3}$ rad

④ $i(t) = \underbrace{1}_{i_0(t)} + \underbrace{1\sin(\omega t)}_{i_1(t)}$ A

$i_{0SR} = 1$ A

$i_{1SR} = 0$ A

$\Big\}\ i_{SR} = i_{0SR} + i_{1SR} = 1$ A

⑤ 

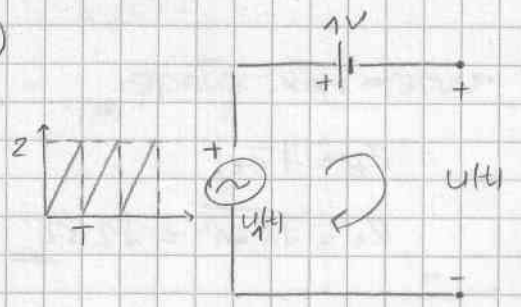
$u(t) = \underbrace{2}_{u_0(t)} + \underbrace{2{,}82\sin(\omega t)}_{u_1(t)}$

$U_{0ef} = 2$ V

$U_{1ef} = \frac{U_{1m}}{\sqrt{2}} = 2$ V

$\Big\}\ U_{ef} = \sqrt{U_{0ef}^2 + U_{1ef}^2} = 2{,}82$ V

(6.)



$u_1(t) - u_0(t) = u(t)$

$u(t) = -1 + u_1(t)$

$U_{sr} = U_{0sr} + U_{1sr}$

$U_{0sr} = -1\ V$

$U_{1sr} = \frac{\frac{1}{2} \cdot 2T}{T} = +1\ V$

$U_{sr} = -1+1 = 0\ V$

(7.) $U_{sr} = 0{,}318\ V$, POLUVALNO ISPRAVLJANJE

$U_{ef} = ?$

$U_{sr} = \frac{U_m}{\pi} \rightarrow U_m = U_{sr} \cdot \pi = 1{,}0\ V$

$U_{ef} = \frac{U_m}{2} \rightarrow U_{ef} = 0{,}5\ V$

(8.) $U_m = 10\ V$, PUNOVALNO ISPRAVLJANJE

$U_{ef} = ?$

$U_{ef} = \frac{U_m}{\sqrt{2}} \rightarrow U_{ef} = 7{,}07\ V$

(9.) $I_m = 1\ A$, POLUVALNO ISPRAVLJANJE

$I_{sr} = ?$

$I_{sr} = \frac{I_m}{\pi} \rightarrow I_{sr} = 0{,}318\ A$

(10.) $u = \underbrace{U_0}_{U_0} + \underbrace{U_{m1} \sin(\omega t)}_{u_1} - \underbrace{U_{m2} \sin(\omega t)}_{u_2}$

$U_{0ef} = U_0$

$U_{1ef} = \frac{U_{m1}}{\sqrt{2}}$

$U_{2ef} = \frac{U_{m2}}{\sqrt{2}}$

$U_{ef} = \sqrt{U_{0ef}^2 + \frac{1}{2}\left(U_{m1}^2 + U_{m2}^2\right)}$

(11) $U_m = 1\ V$, $\varphi = 0$

$f = 50\ Hz \rightarrow \omega = 2\pi f \rightarrow \omega = 100\pi\ rad\ [rad = s^{-1}]$

$t = 1\ s$

$$u(t) = U_m \sin(\omega t + \varphi)$$

$$u(t) = 1 \sin(100\pi t) \rightarrow u(1) = \sin(100\pi) = 0\ V$$

(12.) $U_m = 10\ V$, $\tau = 5\ ms$

$f = 50\ Hz \rightarrow T = \frac{1}{f} = 20\ ms$

$$U_{sr} = \frac{U_m \cdot \tau}{T} \rightarrow U_{sr} = 2.5\ V$$

$$U_{ef} = U_m \sqrt{\frac{\tau}{T}} \rightarrow U_{ef} = 5\ V$$

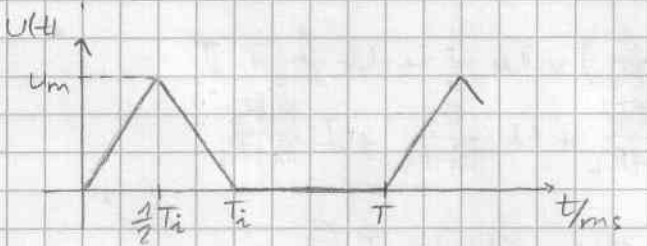
(13.) $U_m = 5\ V$

$T_i = 2\ ms$

$f = 100\ Hz \rightarrow T = \frac{1}{f} = 10\ ms$

$$u(t) = \begin{cases} 5t, & 0 < t < 1 \\ -5t + 10, & 1 < t < 2 \\ 0, & 2 < t < T \end{cases}$$

$$U_{ef} = \sqrt{\frac{1}{10} \cdot \left(\int_0^1 (5t)^2 dt + \int_1^2 (-5t+10)^2 dt \right)}$$

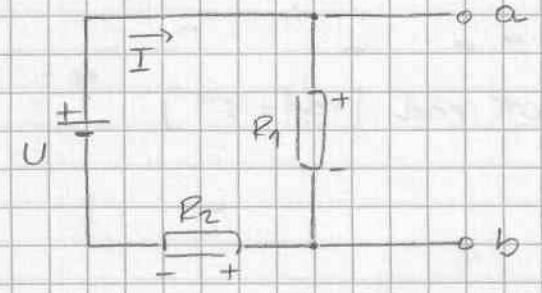


(14.) $u(t) = 50 + U_m \sin(\omega t)$

$U_{ef} = 52\ V$

$$U_{ef} = \sqrt{50^2 + \frac{U_m^2}{2}} \rightarrow U_m = 2\sqrt{92}\ V$$

(15.)



$U = 9V, \quad R_1 = 6\Omega, \quad R_2 = 3\Omega$

$R_T = R_1 \| R_2 \rightarrow R_T = 2\Omega$

$I = \frac{U}{R_1 + R_2} \rightarrow I = 1A$

$U_T = I R_1 \rightarrow U_T = 6V$

(16.) g - GRANE

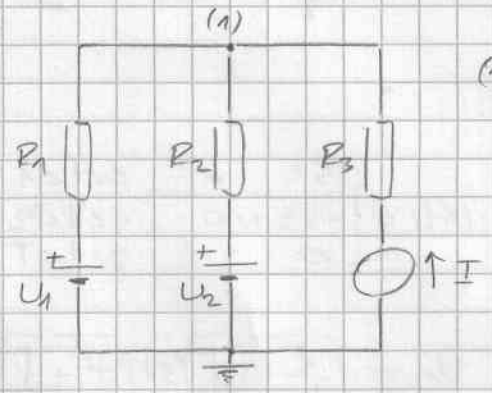
$\check{c}$ - ČVOROVI

n - NEOVISNE JEDNADŽBE

$g = 7 \quad \check{c} = 3$

$n = g - \check{c} + 1 \rightarrow n = 4$

(17.)



① $R_1 = 2\Omega \quad R_2 = 3\Omega \quad R_3 = 4\Omega$

$f_1 = 10V$

② $R_1 = 20\Omega \quad R_2 = 30\Omega \quad R_3 = 40\Omega$

$f_1 = ?$

(1) $f_{11}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = U_1 \frac{1}{R_1} + U_2 \frac{1}{R_2} + I$

$f_{11} = U_1 \frac{R_2}{R_1 + R_2} + U_2 \frac{R_1}{R_1 + R_2} + I \frac{R_1 R_2}{R_1 + R_2}$

- $f_{11} = \frac{1}{5}(3U_1 + 2U_2) + I \frac{6}{5}$
- $f_{11} = \frac{1}{50}(30U_1 + 20U_2) + I \frac{30 \cdot 20}{30 + 20}$

$f_{12} = \frac{1}{5}(3U_1 + 2U_2) + I \frac{60}{5}$

ZAKLJUČAK: NEMA DOVOLJNO PODATAKA! KADA BI ZNALI STRUJU IZVORA, npr. $I = 5A$ DOBILI BI:

$\frac{1}{5}(3U_1 + 2U_2) = f_{11} - I \cdot \frac{6}{5} \rightarrow \frac{1}{5}(3U_1 + 2U_2) = 4$

$f_{12} = 4 + 5 \cdot \frac{60}{5} = 64V$

Trofazni

① faze R → S – T: $U_R = U_f \angle \alpha_R$

$U_S = U_f \angle \alpha_R - 120° = U_f \angle \alpha_S$

$U_T = U_f \angle \alpha_R - 240° = U_f \angle \alpha_T$

$\alpha_R = 0$

$\alpha_S = 0 - 120° = -120° =$

$= -120° \cdot \frac{\pi}{180°} = -\frac{2\pi}{3}$

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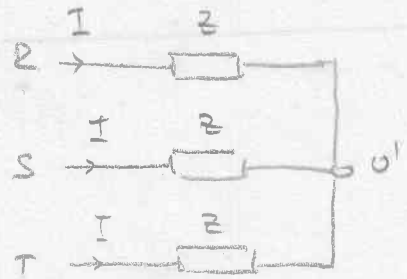
②



$I_L = I_F = I$

$U_F = I \cdot Z$

$U_L = \sqrt{3} \cdot I \cdot Z$

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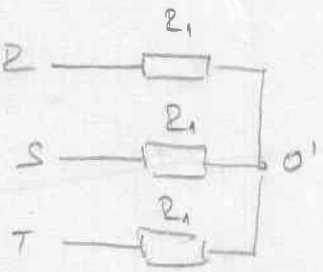
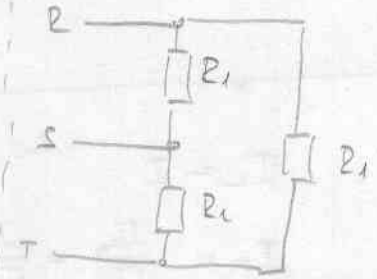
③



$P_{R1} = \frac{U_F^2}{R_1}$

na otporima vlada fazni napon

$P_{UKA} = 3 \cdot \frac{U_F^2}{R_1} = P$



na otporima vlada linijski napon $U_L = \sqrt{3} \cdot U_F$

$P_{R1} = \frac{U_L^2}{R_1} = \frac{(\sqrt{3} U_F)^2}{R_1} = \frac{3 U_F^2}{R_1}$

$P_{UKA} = 3 \cdot \frac{3 U_F^2}{R_1} = 3 \cdot P$

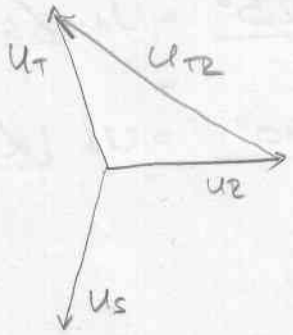
④ $U_f = 220$ V

$\varphi_2 = 0$

$\dot{U}_2 = 220 \angle 0°$

$\dot{U}_S = 220 \angle -120° = -110 - j190$ V

$\dot{U}_T = 220 \angle -240° = -110 + j190$ V



$\dot{U}_2 + \dot{U}_{T2} = \dot{U}_T$

$\dot{U}_{T2} = \dot{U}_T - \dot{U}_2$

$= -110 - j190 - 220$

$= -330 - j190$ V

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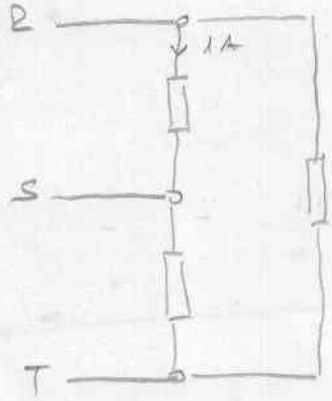
⑤



$I_F = 1$ A

$I_L = \sqrt{3} \cdot I_F = 1{,}73$ A

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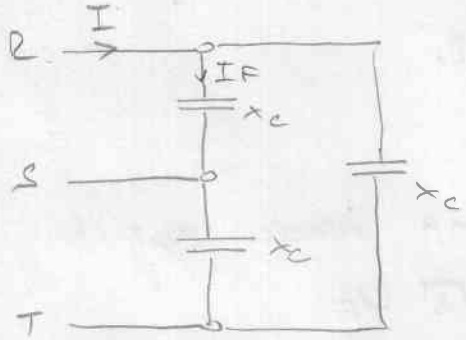
⑥

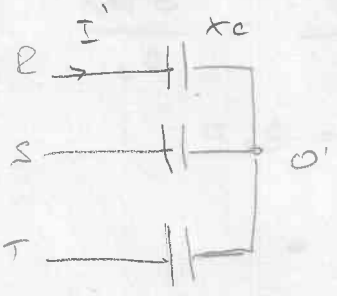


$I_L = I$

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

$U_f = U_L$

$I_F = \frac{U_L}{x_c} \Rightarrow x_c = \frac{U_L}{I} \cdot \sqrt{3}$



$I' = \frac{U_f}{x_c} = \frac{\frac{U_L}{\sqrt{3}}}{\frac{U_L \cdot \sqrt{3}}{I}} = \frac{I}{3}$

PRI SE LA ZVE POSAVE

$$\tau = \frac{L}{R}$$

$$= R \cdot C$$

(1) $$\tau = \frac{L}{R}$$

$$\tau' = \frac{L}{\frac{R}{2}} = \frac{2L}{R} = 2\tau$$

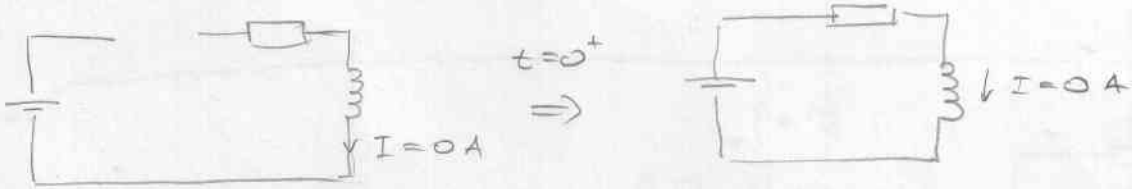
(2) $$\tau = \frac{L}{2R}$$

$$\tau' = \frac{L}{R} = \frac{2}{2} \cdot \frac{L}{R} = 2\tau$$

(3) $$\tau = R \cdot C$$

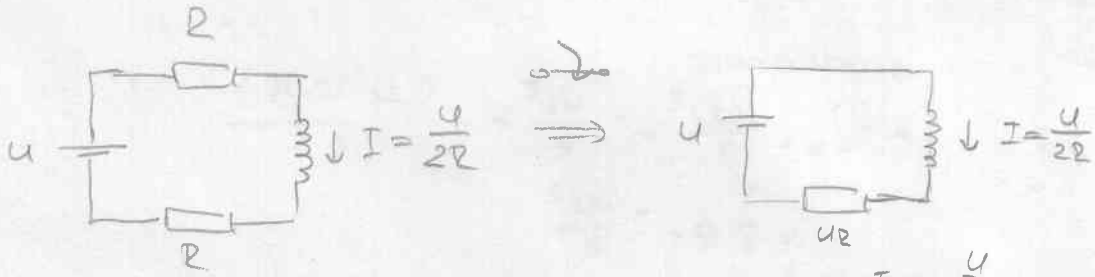
$$\tau' = R \cdot (C \| C) = R \cdot 2C = 2\tau$$

(4)



$$u_R = R \cdot I = 0 \text{ V}$$

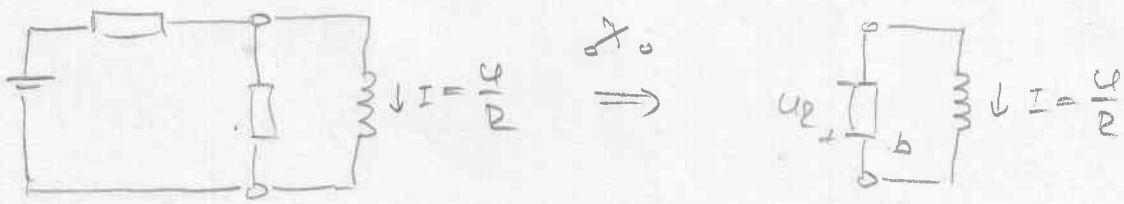
(5)



$$u_R = R \cdot I = \frac{u}{2}$$

$$u_R + u_L = u \Rightarrow u_L = \frac{u}{2}$$

(6)

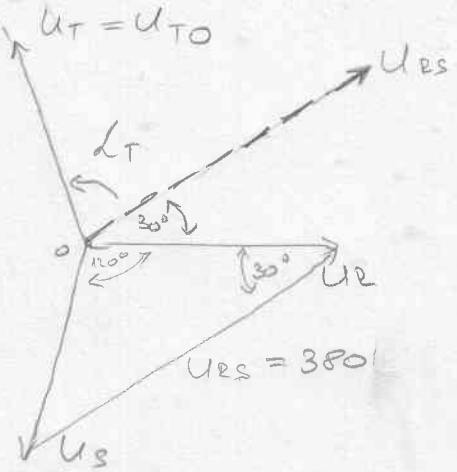


$$u_R = R \cdot I = u$$

$$u_{ab} = -u_R = -u$$

(7) $\dot{U}_{RS} = 380 \angle 0^\circ \ V$

$U_{TO} = ?$



$\alpha_T = 120^\circ - 30^\circ$

$= 90^\circ$

$U_L = 380 \ V$

$U_f = \frac{380}{\sqrt{3}} = 220 \ V$

$\dot{U}_{TO} = 220 \angle 90^\circ \ V$

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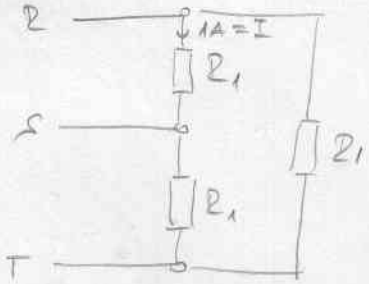
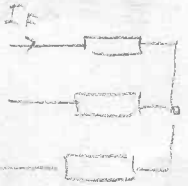
(8)



$U_L = I_F \cdot R_1$

$I_F = \frac{U_L}{R_1}$

$= \frac{U_F \cdot \sqrt{3}}{R_1}$



$I_F' = \frac{U_F}{R_1} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{I_F}{\sqrt{3}} = \frac{1}{1{,}73} \ A$

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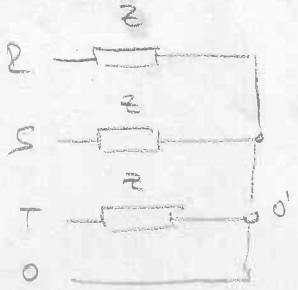
(9)



$S' = ?$

$U' = U_f \cdot 0{,}9$

$S_1 = \frac{U_f^2}{Z} \Rightarrow S_{uk} = 3 \cdot \frac{U_f^2}{Z}$

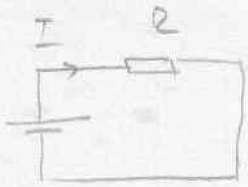
SKANCENIE

$S_{uk}' = \frac{U_f^2}{Z} + \frac{U_f^2}{Z} + \frac{(U_f \cdot 0{,}9)^2}{Z}$

$= 2{,}81 \ \frac{U_f^2}{Z}$

zmanjšje za: $\frac{S_{uk} - S_{uk}'}{S_{uk}} \cdot 100\% = 6{,}\dot{3}\ \%$

(I)



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

U $t=0^+ \Rightarrow C = 0$