③ $u_1 = 8\sin(\omega t) \rightarrow U_1 = \frac{8}{\sqrt{2}}$

$u_2 = 6\sin(\omega t + 90°) \rightarrow U_2 = \frac{6}{\sqrt{2}}\, j$

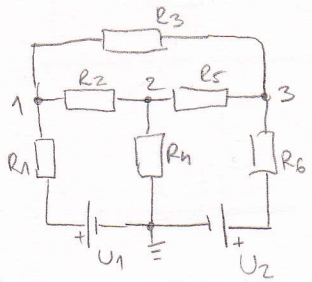
$|\dot{U} = \dot{U}_1 + \dot{U}_2|$

$U = \sqrt{\frac{64}{2} + \frac{36}{2}} = \frac{10}{\sqrt{2}} = 7{,}07 \approx 7\,V$

OE

METODA NAPONA ČVOROVA

①



$$\varphi_1\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) - \varphi_2 \cdot \frac{1}{R_2} - \varphi_3 \cdot \frac{1}{R_3} = \frac{U_1}{R_1}$$

$$-\varphi_1 \cdot \frac{1}{R_2} + \varphi_2\left(\frac{1}{R_2} + \frac{1}{R_4} + \frac{1}{R_5}\right) - \varphi_3 \cdot \frac{1}{R_5} = 0$$

$$-\varphi_1 \cdot \frac{1}{R_3} - \varphi_2 \cdot \frac{1}{R_5} + \varphi_3 \cdot \left(\frac{1}{R_3} + \frac{1}{R_5} + \frac{1}{R_6}\right) = \frac{U_2}{R_6}$$

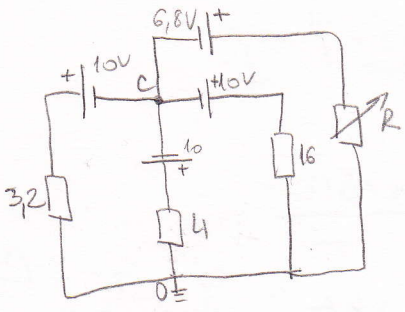
! Ako je + izvora okrenut prema čvoru 1 piseno $+\frac{U_1}{R_1}$.

Naponski izvor ima otpor 0 → ima beskonacnu vodljivost

Strujni izvor ima beskonacan otpor → 0 vodljivost

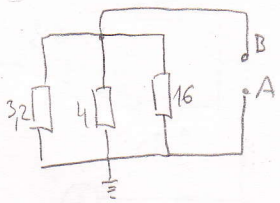
THEVENIN – uvijek, osim kada je otpor beskonacan (RLC) pa onda koristimo Nortona

② 1. ugasiti izvore i izbaciti traženi otpor



⇒

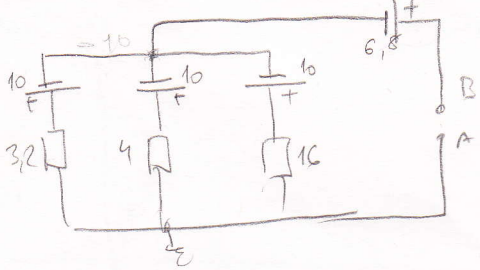
MAX. SNAGA → THEVENIN



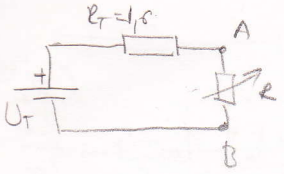
2. izračunati Thevenisnov otpor

$$\frac{1}{R_T} = \frac{1}{3{,}2} + \frac{1}{4} + \frac{1}{16} \Rightarrow R_T = 1{,}6\,\Omega$$

3. vratiti izvore i računati U_{ab}



$U_{ab} = U_T = 1{,}6\,V$



MAX SNAGA: $R = R_T$

$R = 1,6\,\Omega$

MILMANOVOM METODOM DOBIJEMO U_{OC}

$$U_{OC} = \frac{-\frac{10}{3,2} - \frac{10}{4} - \frac{10}{16}}{\frac{1}{3,2} + \frac{1}{4} + \frac{1}{16}} = -10\,V$$

$$U_T = -10 + 6,8 = -3,2\,V$$

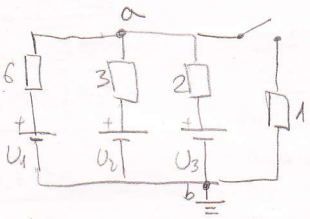
$$I = \frac{U_T}{R + R_T} \qquad P_{MAX} = I^2 \cdot R = 1,6\,W$$

NORTON

(3.) nadomjesna shema:

$$I_N = \frac{U_T}{R_N} = \frac{U_T}{R_T}$$

X.1-13



$U_1 = U_2 = U_3 = 10\,V$

$\varphi_A = ?$

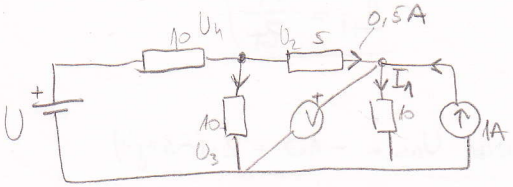
a) $$U_{ab} = \frac{10\left(\frac{1}{6} + \frac{1}{3} + \frac{1}{2}\right)}{\frac{1}{6} + \frac{1}{3} + \frac{1}{2}} = 10\,V \rightarrow \varphi_A = 10\,V$$

$U_{ab} = \varphi_a - \varphi_b = \varphi_a$

b) sklopka zatvorena

$$U_{ab} = \frac{10\left(\frac{1}{6} + \frac{1}{3} + \frac{1}{2}\right)}{\frac{1}{6} + \frac{1}{3} + \frac{1}{2} + 1} = 5\,V \rightarrow \varphi_A = 5\,V$$

X.1-7.



$U_V = 15\,V$

$U = ?$

$$I_1 = \frac{15\,V}{10\,\Omega} = 1,5\,A \qquad U_2 = 5 \cdot 0,5 = 2,5\,V \qquad U_3 = 2,5 + 15 = 17,5\,V$$

$$I_3 = \frac{17,5}{10} = 1,75\,A$$

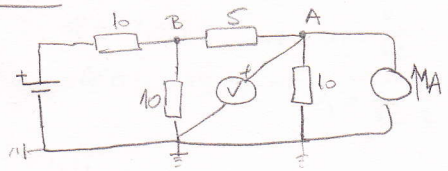
$I_4 = 1,75 + 0,5 = 2,25\,A$

$U_4 = 22,5\,V$

$U = U_3 + U_4$

$U = 40\,V$

2. način



$\varphi_A = 15V$

$\varphi_A\left(\frac{1}{6}+\frac{1}{5}\right) - \varphi_B \cdot \frac{1}{5} = 1$

$15 \cdot \frac{3}{10} - 1 = \frac{1}{5}\varphi_B$

$\frac{7}{2} = \frac{1}{5}\varphi_B$

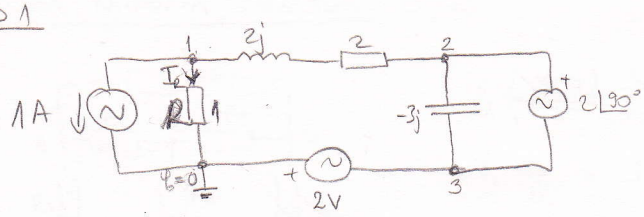
$\varphi_B = 17{,}5V$

$\varphi_B\left(\frac{1}{5}+\frac{1}{10}+\frac{1}{10}\right) - \varphi_A \cdot \frac{1}{5} = \frac{U}{10}$

$17{,}5 \cdot \frac{2}{5} - 15 \cdot \frac{1}{5} = \frac{U}{10}$

$U = 40V$

ZAD 1



$I_R = \frac{U_R}{R} = \frac{\varphi_1 - \varphi_0}{1} = \frac{\varphi_1}{1}$

$\varphi_3 = -2V$

$\varphi_2 = -2V + 2jV = -2+j2$

$I_R = ?$

$\varphi_1 \cdot \left(\frac{1}{1}+\frac{1}{2+j2}\right) - \varphi_2 \cdot \frac{1}{2+j2} = -1$

$\varphi_1 \left(\frac{3+j2}{2+j2}\cdot\frac{2-j2}{2-j2}\right) - (-2+j2)\cdot\frac{1}{2+j2}\cdot\frac{2-j2}{2-j2} = -1$

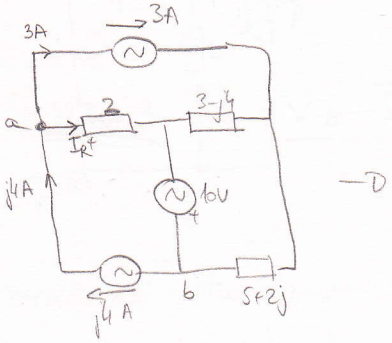
$\varphi_1 \cdot \left(\frac{5}{4}-\frac{1}{4}j\right) - j = 1$

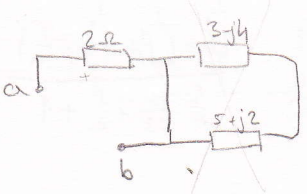
$\varphi_1 = \frac{1+j}{\frac{5}{4}-\frac{1}{4}j}$

$\varphi_1 = \frac{8}{13}+\frac{12}{13}i = 1{,}1\angle 56°$

$I_R = 1{,}1\angle 56°$

ZAD 2





$Z_N = Z_T = 2\Omega$

$I_N = \frac{U_T}{Z_T}$

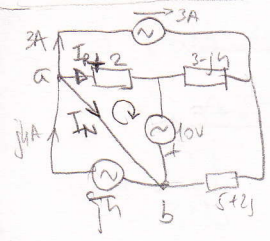
PO THEVENINU $U_{ab} = -10 + 2\cdot(-3+j4)$

$U_{ab} = -10 - 6 + j8$

$U_{ab} = -16 + j8\ V$

$I_N = \frac{-16+j8}{2} = -8+j4\ A$

$I_N, I_{KS} = ?$



$j4 = I_N + I_R + 3$

$j4 = I_R + 3$

$I_R = -3+j4\ A$

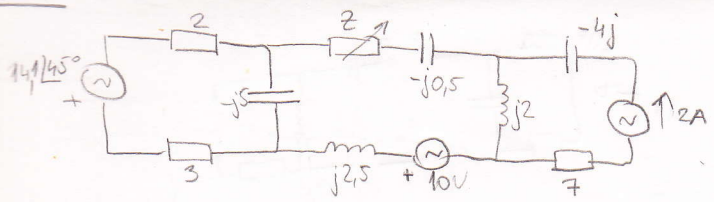
$-2\cdot I_R + 10V = 0$

$I_R = 5A$

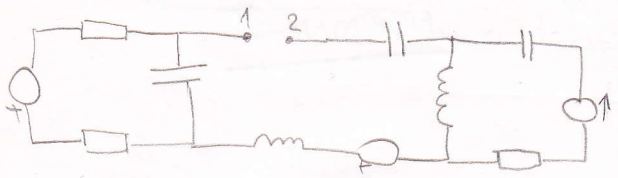
$I_N = j4 - 5 - 3$

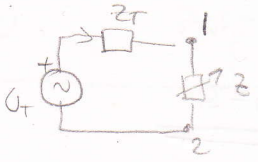
$I_N = -8+j4\ A$

ZAD 3



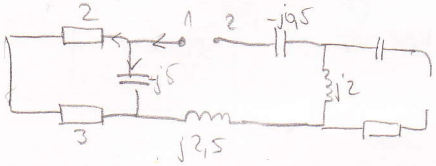
P_{MAX} na Z





ZA MAX SNAGU:

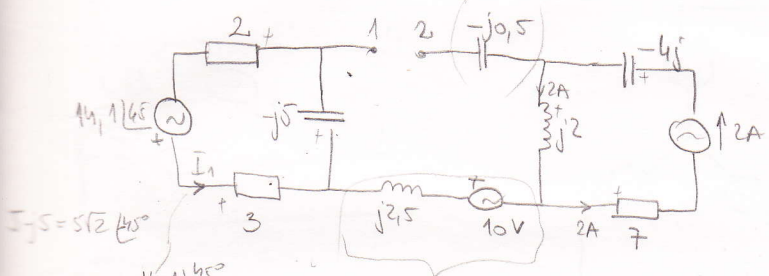
$Z = Z_T^*$



$$Z_T = -j0,5 + j2 + j2,5 + \frac{5 \cdot (-j5)}{5 - j5} = j4 + \frac{-j25}{5-j5} \cdot \frac{5+j5}{5+j5} =$$

$$= j4 + \frac{75 - j75}{50} = j4 + 2,5 - j2,5 = \underline{2,5 + j1,5\,\Omega}$$

$$\underline{Z = 2,5 - j1,5\,\Omega}$$



$I_{-j5} = 5\sqrt{2}\,\angle 45°$

$$I_1 = \frac{14,1\angle 45°}{5\sqrt{2}\angle -45°}$$

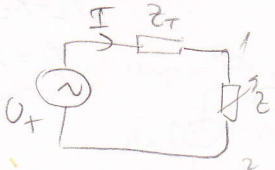
$$\underline{I_1 = 2\angle 90°\ A}$$

$$\underline{I_1 = j2A}$$

tu ne teče struja, ne možemo napraviti krug, jer je gore „rupa"

$$U_T = U_{12} = -j2 \cdot 2 + 10V - j2 \cdot (-j5)$$

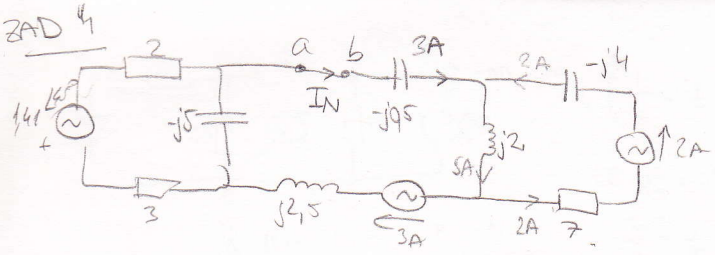
$$\underline{U_T = U_{12} = -j4 + 10 - 10 = -j4\,V}$$

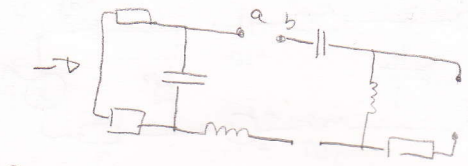


$$\underline{I = \frac{-j4}{5} = -j0,8}$$

$$\underline{P = I^2 \cdot Re\{Z\} = 0,64 \cdot 2,5 = 1,6\,W}$$

ZAD 4

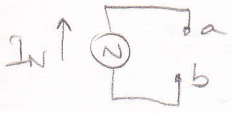




$Z_N = \infty$

↓

koristimo NORTONA!



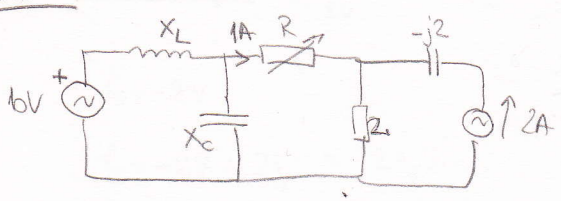
$I_N = 3A$

↑ Što god stavili na ab struja će ostati ista

$Z_T = 0$

THEVENIN!

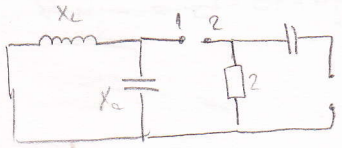
ZAD 5



Odrediti struju kroz R koja će biti uvijek ista (1A) bez obzira na R!

$I_N = 1A$

$Z_N = \infty$

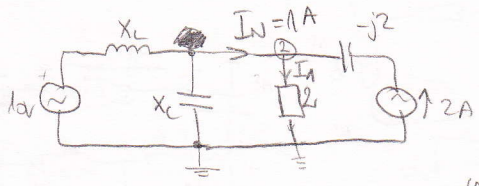


$$Z_N = \frac{jX_L \cdot (-jX_C)}{j(X_L - X_C)} + 2 = \infty$$

↓

$X_L - X_C = 0$

$X_L = X_C$



$$\varphi_2 \left(\frac{1}{jX_L} + \frac{1}{-jX_C} + \frac{1}{2} \right) = \frac{10}{X_L} + 2$$

$I_N + 2 = I_1$

$$\varphi_2 = \frac{20}{jX_L} + 4$$

$I_1 = \frac{\varphi_2}{2}$

$$I_N = I_1 - 2 = \frac{10}{jX_L} + 2 - 2 = \frac{10}{jX_L}$$

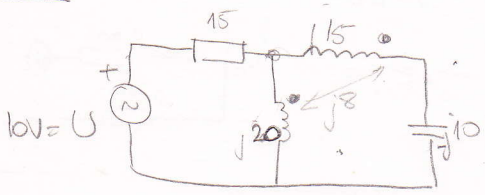
$$|I_N| = 1 = \frac{b}{X_L}$$

$X_L = 10\ \Omega$

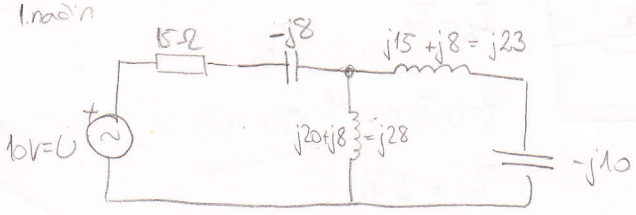
$X_C = 10\ \Omega$

MEĐUINDUKTIVITET

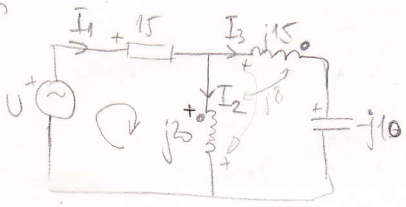
ZAD 1



1. način



2. način

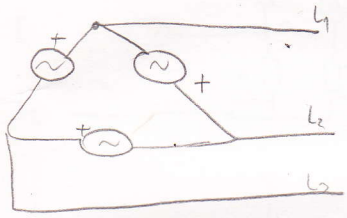


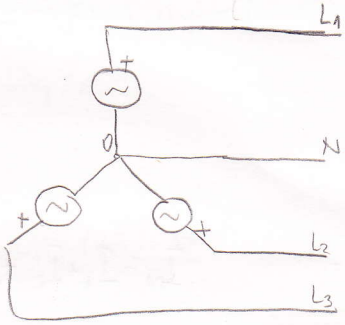
$I_1 = I_2 + I_3$ → preskačemo plus

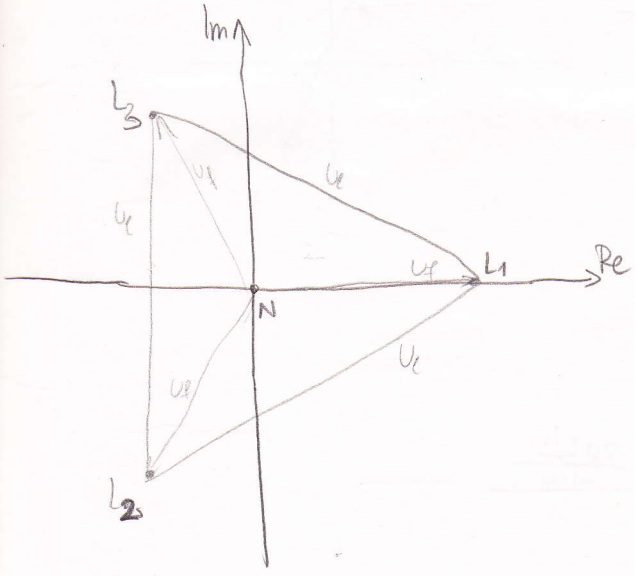
$U - 15 I_1 - j20 \cdot I_2 + j8 \cdot I_3 = 0$

$j20 \cdot I_2 - j8 \cdot I_3 - j15 \cdot I_3 + j8 I_2 - (-j10) \cdot I_3 = 0$

TROFAZNI







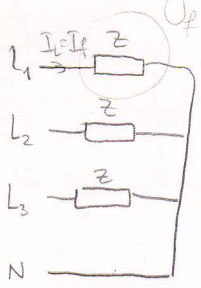
linijski napon → napon između L_1, L_2 i L_3

fazni napon → napon u pojedinoj fazi; napon između linije i nule

$U_f = 220/380$ V, 50 Hz → gradska mreža

U_f / U_L

$$U_L = \sqrt{3}\, U_f$$



$U_f = 220V$

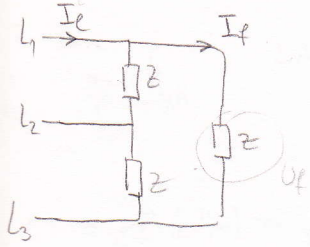
$U_l = \sqrt{3}\, U_f$

$I_L = I_f$

TROŠILO SPOJENO U ZVIJEZDU

$P_1 = U_f \cdot I_f \cdot \cos\varphi$

$P_{UK} = 3 \cdot P_1$



$U_f = U_l = 380V$!!!

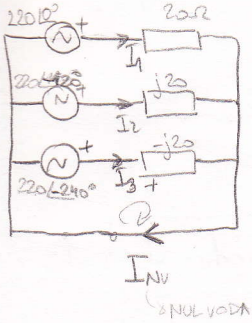
TROŠILO SPOJENO U TROKUT

$I_l = \sqrt{3} \cdot I_f$

$P_1 = U_f \cdot I_f \cdot \cos\varphi$

$P_\Delta = 3 P_\lambda$ → ovaj U_f je 380V, a ne 220V

nesimetrično trošilo



$I_3 = \frac{220\angle 120°}{-j20} = \frac{220\angle 120°}{20\angle -90°}$

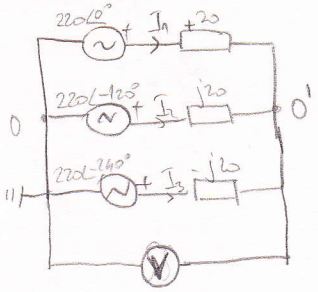
$I_2 = \frac{220\angle -120°}{j20}$

$I_1 = \frac{220\angle 0°}{20} = 11$

$\underline{I}_N = \underline{I}_1 + \underline{I}_2 + \underline{I}_3$

$I_N =$

PREKID U NUL VODU



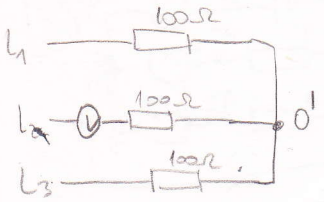
$U_{OO'} = \frac{\frac{220}{20} + \frac{220\angle -120°}{j20} + \frac{220\angle -240}{-j20}}{\frac{1}{20} + \frac{1}{j20} + \frac{1}{-j20}}$

$U_V = |U_{OO'}| = -161$?

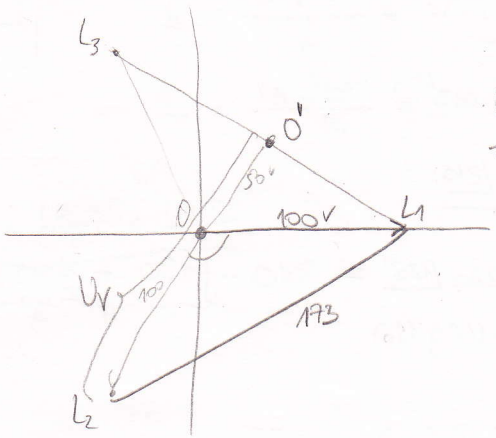
$U_{OO'} = I_1 \cdot 20 - 220\angle 0°$

$I_1 = 2,95$

ZAD 1

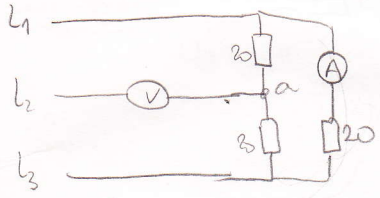


izvor linijskog napona 173V



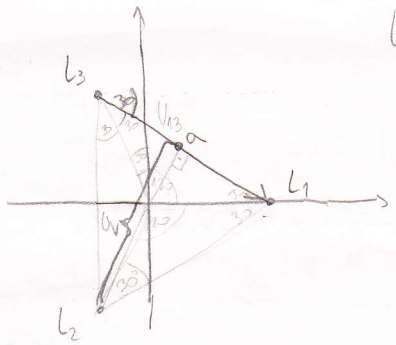
$U_V = 150\,V$

ZAD 2



izvor linijskog napona 173V

$U_V, I_A = ?$



$U_{13} = 173\angle -30$

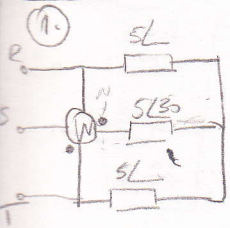
$I_A = \frac{173\angle -30°}{20} = 8{,}65\angle -30°\ A$

$U_V = 150\,V$

$U_V = \sqrt{U_{13}^2 - \left(\frac{U_{13}}{2}\right)^2} = \sqrt{173^2 - \left(\frac{173}{2}\right)^2} = 150\,V$

OE

1.



$U_L = 380V \rightarrow U_f = 220V$

U_f

→ simetrično trošilo

watmetar mjeri: $P_w = U \cdot I \cdot \cos\varphi$

$$\underline{I} = \frac{U_f}{5\angle 30} = \frac{220\angle 240}{5\angle 30} = 44\angle 210$$

$$\underline{U_w} = \varphi_R - \varphi_T = 220\angle 0° - 220\angle 120° = 330 - j190 = 380\angle 30$$

$$-(-110 + j190)$$

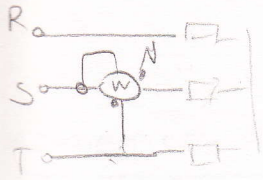
$210+30=240$

$360-240=120$

$\varphi = 120°$

$P = 44 \cdot 380 \cdot \cos 120°$

$P_w = -8{,}33\,kW$



b) $U = 220\angle 240 - 220\angle 120° = -j380\,V = 380\angle -90$

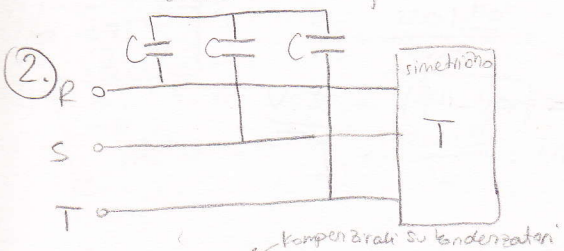
$I = 44\angle 210°$

$P = 44 \cdot 380 \cos 60°$

$P = 8{,}33\,kW$

kondenzatori u zvijezdi – $U_f = \frac{U_l}{\sqrt{3}}$

2.



$U_l = 380V$

$f = 50Hz$

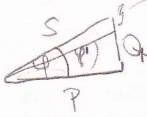
$P = 3500W$

$P_1 = \frac{3500}{3} = 1166{,}6\,W$

$\cos\varphi = 0{,}6 \rightarrow \varphi = 53{,}13°$

$\cos\varphi' = 98 \rightarrow \varphi' = 38{,}39°$

kompenzirali su kondenzatori



$tg\varphi = \frac{Q_1}{P}$

$Q_1 = 1555\,VAr$

$Q_2 = P_1 \cdot tg(38{,}39)$

$Q_2 = 924\,VAr$

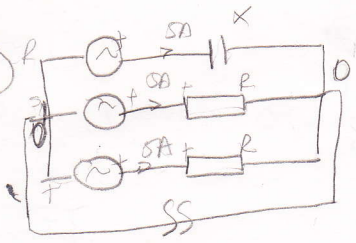
$Q_c = Q_1 - Q_2 = 631$

$Q_c = \frac{U_f^2}{X_c} \Rightarrow X_c = \frac{U_f^2}{Q_c} = 76{,}7\,\Omega$

$X_c = \frac{1}{2\pi f C} \rightarrow C = \frac{1}{2\pi f X_c} = 41{,}5\,\mu F$

③

Zad. 1-13



$$\underline{I}_R = \frac{U_f \angle 0^\circ}{-jX} = 5A \angle 90^\circ$$

$$\underline{I}_S = \frac{U_f \angle 240^\circ}{R} = 5A \angle 240^\circ$$

$$\underline{I}_T = \frac{U_f \angle 120^\circ}{R} = 5A \angle 120^\circ$$

$X = R$ → jer su struje iste kad je naponski spojen (napomi su izh')

$$U_{00'} = \frac{\frac{U_f \angle 0^\circ}{-jX \cdot R} + \frac{U_f \angle 240^\circ}{R} + \frac{U_f \angle 120^\circ}{R}}{\frac{1}{-jX} + \frac{1}{R} + \frac{1}{R}}$$

$\frac{1}{-jR} \cdot \frac{j}{j} = \frac{j}{R}$ $\quad (-jR)$

$$U_{00'} = \frac{5\angle 90^\circ + 5\angle 240^\circ + 5\angle 120^\circ}{\frac{j}{R} + \frac{1}{R} + \frac{1}{R}} = \frac{j5 - 2{,}5 - 2{,}5}{\frac{2+j}{R}} = \frac{j5-5}{2+j} \cdot R = (-1+j3)R$$

$$U_f - U_{TR} = U_{00'}$$

$$U_{TR} = U_f - U_{00'}$$

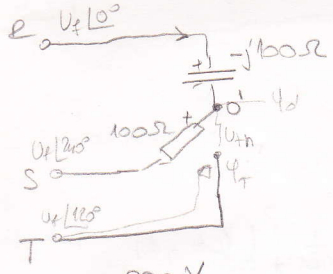
$$\underline{I} = \frac{U_f^1 - U_{00'}}{R}$$

$U_L = 5\angle 90^\circ \cdot (-jR)$

$$\underline{I} = \frac{j5 \cdot (-jR) - (-1+j3) \cdot R}{-jR} = \frac{5+1-j3}{-j} = \frac{6-j3 \cdot j}{-j \cdot j} = -3-6j$$

$$|I| = 2A$$

④



$U_f = 220\,V$

$$Z_T = 100 \| -j100 = 50 - j50\,\Omega$$

$$U_{RS} = \varphi_R - \varphi_S = 220\angle 0^\circ - 220\angle 240^\circ = 330 + j190$$

$$Z_{UL} = 100 - j100$$

$$\underline{I} = \frac{330 + j190^\circ}{100 - j100} = 0{,}7 + j2{,}6$$

$$220\angle 240^\circ + I \cdot 100 = \varphi_{0'}$$

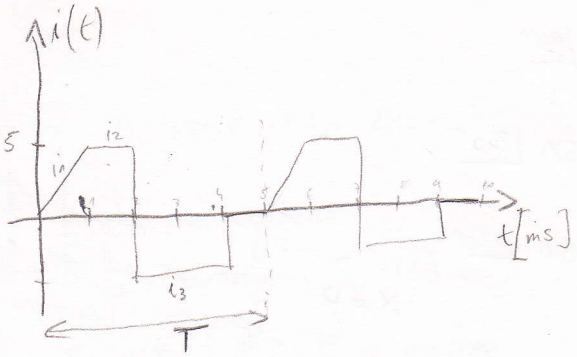
$$220\angle 240^\circ + 100(0{,}7 + j2{,}6) = \varphi_{0'} \Rightarrow \varphi_{0'} = -40 + 70j$$

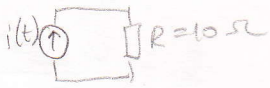
$$U_{TH} = U_f \angle 120^\circ - \varphi_{0'}$$

$$U_{TH} = -70 + j120$$

$$|U_{TH}| = 138{,}92\,V$$

1.





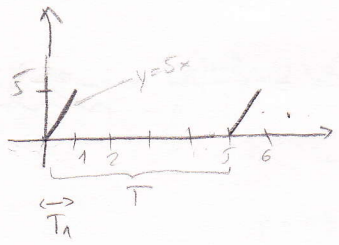
$$I_{sr} = \frac{1}{T}\int_T i(t)\,dt \qquad I_{ef} = \sqrt{\frac{1}{T}\int_T (i(t))^2\,dt}$$

$$I_{sr} = I_{sr0}\cdot\frac{T_1}{T} \qquad I_{ef} = I_{ef0}\sqrt{\frac{T_1}{T}}$$

(osnovni oblika)

$$I_{ef} = \sqrt{I_{1ef}^2 + I_{2ef}^2 + I_{3ef}^2 + \dots}$$

$$I_{sr} = I_{1sr} + I_{2sr} + I_{3sr} + \dots$$

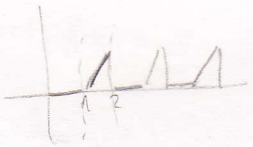


$$I_{sr1} = \frac{1}{5}\int_0^1 5t\,dt = \frac{1}{5}\cdot 5\cdot\frac{t^2}{2}\Big|_0^1 = \frac{1}{2}\,A$$

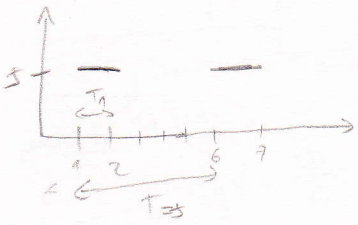
$$I_{sr1} = I_{sr0}\cdot\frac{T_1}{T} = \frac{I_m}{2}\cdot\frac{1}{5} = \frac{1}{2}$$

$$I_{ef} = \sqrt{\frac{1}{5}\int_0^1 (5t)^2\,dt} = \frac{\sqrt{15}}{3}$$

$$= \frac{I_m}{\sqrt{2}}\cdot\sqrt{\frac{T_1}{T}} = \frac{5}{\sqrt{2}}\cdot\sqrt{\frac{1}{5}} = \frac{\sqrt{15}}{3}$$



$$I_{sr} = \frac{1}{2}\int_1^2 10t = \frac{1}{2}\int_1^2 (10t - 10)$$

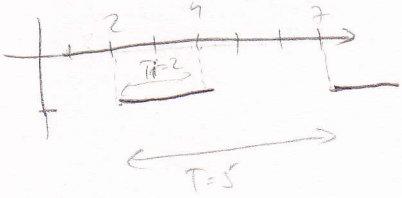


$$I_{2sr} = \frac{1}{5}\int 5\,dt = 1$$

$$= I_m\cdot\frac{T_1'}{T} = 5\cdot\frac{1}{5} = 1$$

$$I_{ef} = \sqrt{\frac{1}{5}\int 5^2\,dt} = \sqrt{5}$$

$$= I_m\cdot\sqrt{\frac{T_1'}{T}} = 5\cdot\frac{1}{\sqrt{5}} = \sqrt{5}$$



$$I_{3sr} = -5\cdot\frac{2}{5} = -2$$

$$I_{3ef} = 115\cdot\sqrt{\frac{2}{5}} = 115\cdot\frac{\sqrt{2}}{\sqrt{5}}\cdot\frac{\sqrt{5}}{\sqrt{5}} = \sqrt{10}$$

▽ u SR ostavljamo −,
○ a u EF je uvijek +

$$I_{sr} = \frac{1}{2} + 1 + (-2) = -\frac{1}{2}$$

$$I_{ef} = \sqrt{\frac{15}{9} + 5 + 10} = \frac{5}{3}\sqrt{6}$$

FAKTOR OBLIKA: $\xi = \frac{U_{ef}}{U_{sr}} = \frac{I_{ef}}{I_{sr}}$

TJEMENI FAKTOR: $\sigma = \frac{U_m}{U_{EF}} = \frac{I_m}{I_{ef}}$

ZI 2007

① $I_{ef} = 0{,}1 \cdot \sqrt{0{,}1}$

$I_{sr} = 0{,}1 \cdot 0{,}1 = 0{,}01$

$\xi = \frac{0{,}1 \cdot \sqrt{0{,}1}}{0{,}01} =$

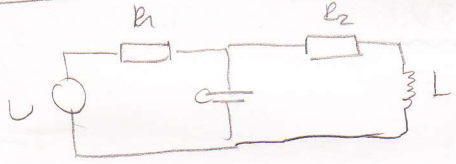
⑨ $I_{sr} = \frac{6}{2} \cdot \frac{3}{5} = 1{,}8\ A$ $\quad I_{ef} = \frac{6}{\sqrt{3}} \cdot \sqrt{\frac{3}{5}} = \frac{6\sqrt{5}}{5}$

Ld teče kroz $R = 10\Omega$

$P_{sr} = I^2 R = 1{,}8^2 \cdot 10 =$ $\quad P_{sr} = I_{ef}^2 \cdot R = \frac{36}{5} \cdot 10 = 72\,W$

SREDNJA SNAGA = RADNA SNAGA

ZAD 1



$R_1 = 1\Omega$
$R_2 = 1\Omega$
$\omega L = 1\Omega$
$\frac{1}{\omega C} = 2\Omega$

$I_{ef(R1)} = ?$

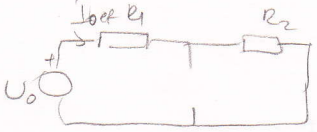
$u(t) = 2 + 2\sqrt{2}\sin(\omega t) + 7{,}07 \cdot \sin(2\omega t)$

$u(t) = U_0 + U_1 + U_2$

tražimo I_{ef}, pa ćemo svugdje tražiti U_{ef}

$U = U_0 = 2$ → nulti harmonik → istosmjerna komponenta ($\omega = 0$) → $X_L = \omega L = 0$

↳ $U_0 = U_{0sr} = U_{0EF}$ $\quad X_C = \frac{1}{\omega C} = \infty$

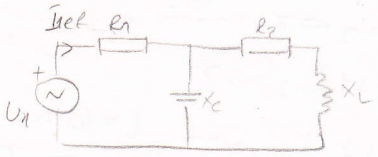


$I_{0ef} = \frac{2}{R_1 + R_2} = 1A$

$U = U_1 = 2\sqrt{2}\sin\omega t \rightarrow U_{sr} = 0V$ $\quad U_{1ef} = 2$

$\omega = 2\pi f$

$Z_{ul} = \frac{(R_2 + jX_L) \cdot (-jX_C)}{R_2 + jX_L - jX_C} + R_1$



$X_L = \omega L = 1\Omega$

$X_C = \frac{1}{\omega C} = 2\Omega$

$R_{ul} = 3\Omega$

$I_{1ef} = \frac{2}{3} = \frac{2}{3}\ A$

$U = U_2 = 7{,}07 \cdot \sin 2\omega t \rightarrow U_{sr} = 0$

$U_{ef} = 5V$

$X_L = 2\omega L = 2\Omega$

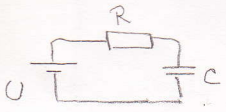
$X_C = \frac{1}{2\omega C} = 1\Omega$

$I_{2ef} = \frac{5}{1\sqrt{2}} = \frac{\sqrt{2}}{6}\ A$

$R_{ul} = 1 - 1j = 1\sqrt{2}\ \angle -45°$

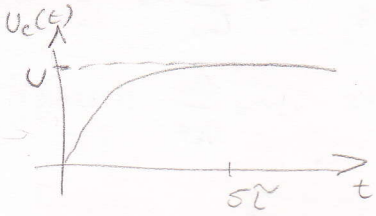
$I_{ef} = \sqrt{I_0^2 + I_1^2 + I_2^2} = \frac{\sqrt{6}}{2}$

PRIJELAZNE POJAVE



$U_c(t) = U\left(1-e^{-\frac{t}{\tau}}\right)$

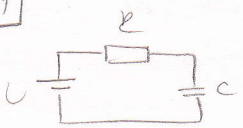
$U_c(t) = U_c(0) + \Delta U\left(1-e^{-\frac{t}{\tau}}\right)$



sada se kondenzator napunio do kraja

$\tau = R \cdot C$

PR. 1



$U = 12V$
$C = 1\mu F$
$R = 1000\Omega$

$U_R(t=20ms) = ?$

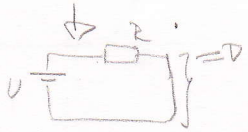
$\tau = R \cdot C = 10ms$

$Q(0) = 0C$

$C = \frac{Q}{U} \Rightarrow U_c(0) = \frac{Q(0)}{C} = 0V$

$U_c(t) = 0 + \underbrace{12}_{\Delta U}\left(1-e^{-\frac{t}{10^{-2}}}\right)$

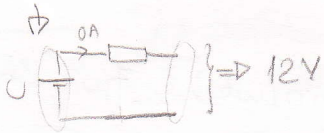
$t=0 \rightarrow R_c = 0$



$U_c(t) = 12 - 12e^{-\frac{20\cdot10^{-3}}{10^{-2}}}$

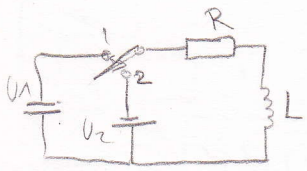
$= 10,38V$

$t > 5\tau \rightarrow R_c = \infty$



$U_R(t_0) = 12 - 10,38 = 1,62V$

PR 2.



$U_1 = 10V$
$U_2 = 30V$
$R = 10\Omega$
$L = 0,1H$

$\tau = \frac{L}{R} = 10ms$

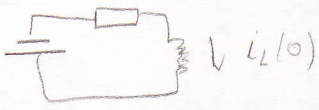
$i_L(t) = i_L(0) + \Delta I\left(1-e^{-\frac{t}{\tau}}\right)$

(S) $\rightarrow$ $t=0 \rightarrow 1$

$t = 10ms \rightarrow 2$

$U_L(30ms) = ?$

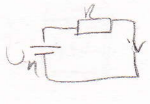
$t = 10ms \Rightarrow S \Rightarrow 2$



$t=0 \Rightarrow S=1$

$t=0 \Rightarrow R_L = \infty$

$t = 5\tau \rightarrow R_L = 0$

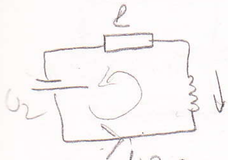


$\rightarrow I = \frac{U}{R} = 1A$

$i_L(t) = 0 + 1\left(1-e^{-\frac{t}{10^{-2}}}\right)$

$i_L(t=10ms) = 0,63A$

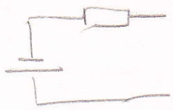
t=10ms ⇒ S → 2



$i_L(0) = -0{,}63A$

i_{L2}

t=0 → $R_L = \infty$

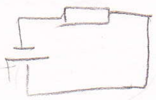


$\downarrow 0{,}63A$

zavojnica kroz neko vrijeme zadržava struju,

a kondenzator zadržava napon

$t = 5\tau \to R_L = 0$



$\uparrow I = \frac{U_2}{R} = 3A$

$$i_{L2}(t) = -0{,}63 + \underbrace{3{,}63}_{\Delta I}\left(1 - e^{-\frac{t}{10^{-2}}}\right)$$

tražimo U u 30s

a mi smo za i_{L1} već koristili 10ms

$$i_{L2}(t=20) = -0{,}63 + 3{,}63\,(1 - e^{-2}) = 2{,}5A$$

$$U_R(t) = I_R(t) \cdot R$$

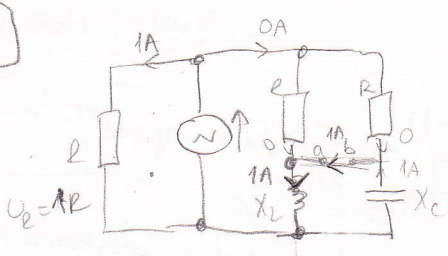
$$U_R(t_0) = 25V$$

$$U_2(t) - U_R(t) - U_L(t) = 0$$

$$U_L(t) = U_2(t) - U_R(t)$$

$$U_L(t_0) = 30 - 25 = 5V$$

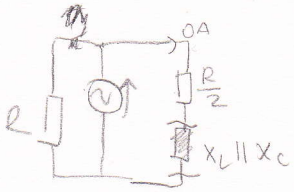
1.9.



$I = 1A$

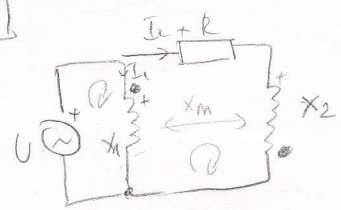
$R = X_L = X_C$

$I_N = ?$



$I_N = 1A$

1.17



$R = 25\Omega$

$X_1 = X_2 = 25\Omega$

$X_M = 20\Omega$

$U = 25V$

$P = ?$

$$U_1 - I_1 \cdot X_1 + I_2 \cdot X_M = 0$$

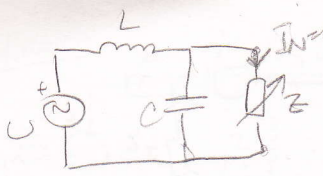
$$-I_2 \cdot R - I_2 \cdot X_2 + I_1 \cdot X_M + I_1 \cdot X_1 - I_2 \cdot X_M = 0$$

$$U = I_2 R + I_2 X_2 - I_1 X_M$$

$I_1, I_2 \dots$

$P = I^2 \cdot R =$

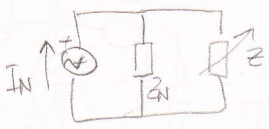
1.5)



$I_N = 0{,}1\,A$

$U = 120\,V$

$f = 50\,Hz$



$Z_N = \infty$

$X_L = X_C$

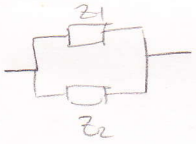
$Z_{ab} = X_L$ $\quad 0{,}1 = \frac{120}{X_L}$ $\quad X_L = 1{,}2k\Omega$

$X_L = \omega L$ $\quad L = \frac{1200}{314} = 3{,}82H$

$\frac{1}{\omega C} = 1200^{-X_L}$

$C = \frac{1}{\omega X_L} = 2{,}65\,\mu F$

3.)



$Z_1 = 7j$

$Z_2 = 6-8j$

$P = 2000W$

$P = U \cdot I \cdot \cos\varphi = S \cdot \cos\varphi$

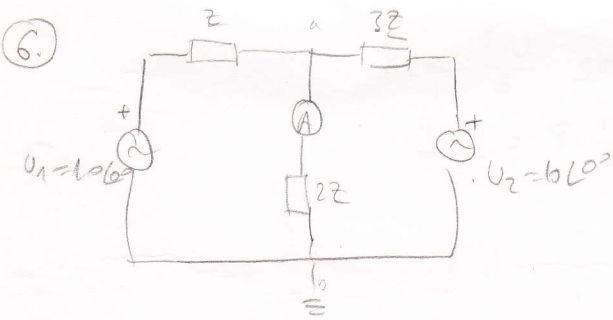
$Z_{ab} = 12\angle\varphi$

$Z_{ab} = \frac{Z_1 Z_2}{Z_1 + Z_2} = 4{,}58 - j1{,}38 = 4{,}79\angle -17°$

$S = \frac{P}{\cos\varphi} = \sqrt{P^2 + Q^2}$ $\quad S = \frac{Q}{\sin\varphi}$

$Q = -600\,VAr$

6.)

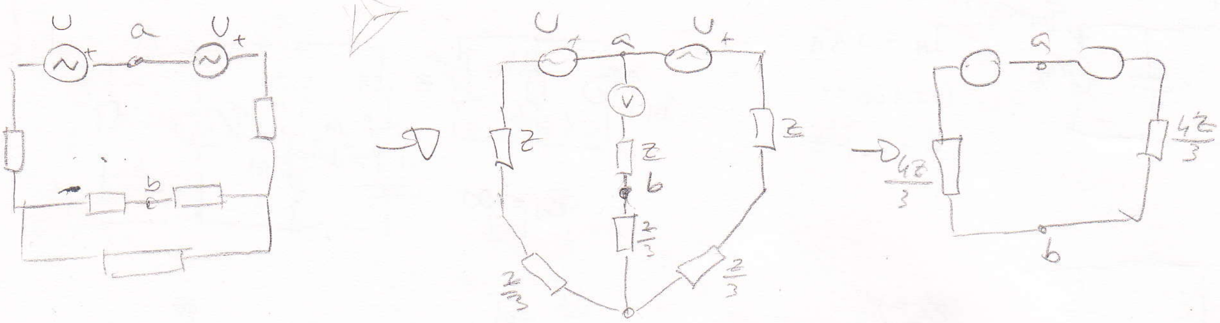


$U_{ab} = \frac{\frac{U_1}{Z} + \frac{U_2}{3Z}}{\frac{1}{Z} + \frac{1}{2Z} + \frac{1}{3Z}} = \frac{10 + \frac{6}{3}}{1 + \frac{1}{2} + \frac{1}{3}} = 7{,}27V$

$I = \frac{U_{ab}}{2Z} \Rightarrow Z = 3{,}64\Omega$

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

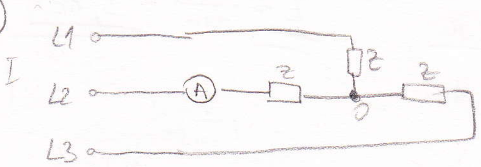
(8)



Z1/2008

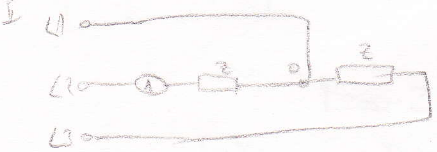
(7.)

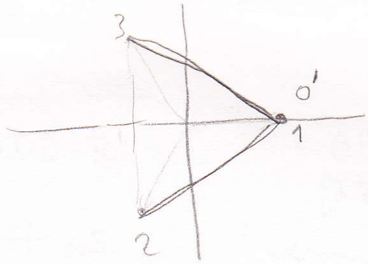
I



$$\underline{I}_A = \frac{U_f}{Z}$$

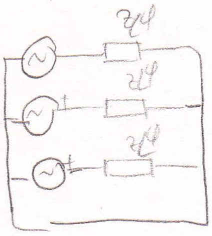
II





$$\underline{I}'_A = \frac{\sqrt{3}\,U_f}{Z} = \sqrt{3}\,\underline{I}_A$$

(8)



$$P = 3 \cdot \frac{U_f^2}{Z} \cos\varphi$$

$$U' = 0{,}85\,U_f$$

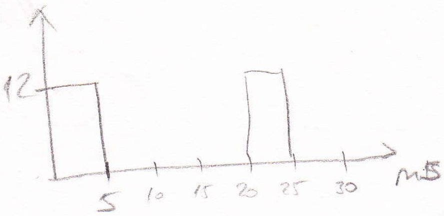
$$P' = 2 \cdot \frac{U_f^2}{Z} \cdot \cos\varphi + \frac{(0{,}85\,U_f)^2}{Z} \cdot \cos\varphi$$

$$P' = 2{,}72\,\frac{U_f^2}{Z} \cdot \cos\varphi$$

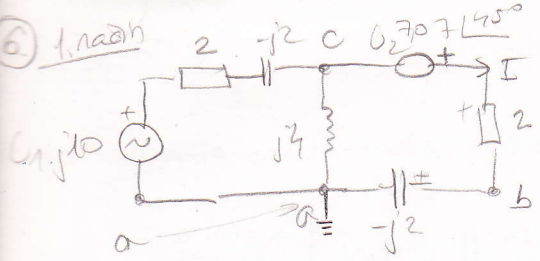
$$P' = \frac{2{,}72}{3}\,P = 0{,}9\,P$$

Z1/2009.

(2)



⑥ 1. način



$\varphi_A = 0$

$$\varphi_b\left(\frac{1}{-j2}+\frac{1}{2}\right) - \varphi_c\left(\frac{1}{2}\right) = \frac{7{,}07}{2}$$

$$-\varphi_B\frac{1}{2} + \varphi_c\left(\frac{1}{j4}+\frac{1}{2}+\frac{1}{2-j2}\right) = \frac{10}{2-j2} - \frac{7{,}07}{2}$$

$U_{ab} = \varphi_a - \varphi_B =$

2. način

bez ovora bočne

$$U_{ac} = \frac{-\frac{U_1}{2-j2} + \frac{U_2}{2-j2}}{\frac{1}{2-j2}+\frac{1}{j4}+\frac{1}{2-j2}}$$

$U_{ac} = U_2 - I\cdot 2 - I(-j2)$

$U_{ac} = U_2 - 2I + j2I$

$I = \ldots$

$U_{ab} = -I\cdot(-j2)$

$U_{ab} =$