Zadatak 1

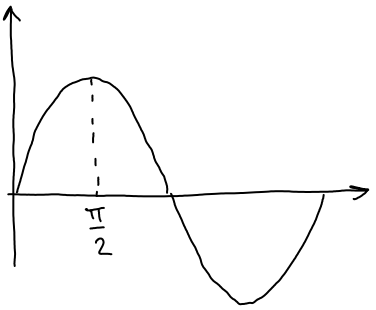
5. prosinca 2012. 16:03

(1) $U_{ef} = 200\,V$, $f = 50\,Hz$

$t_1 = \frac{1}{300}\,s$

$u(t) = U_m \cdot \sin(\omega t)$

$u_{ef} = U_m \cdot \sqrt{2} = 282\,V$



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za maximum vrijedi:

$\sin(\omega t) = 1 \Rightarrow \omega t = \frac{\pi}{2} \Rightarrow t = \frac{\pi}{2\omega} = \frac{\pi}{2 \cdot 2\pi f} = \frac{1}{200}\,s = 5\,ms = t_{max}$

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za $t = t_{max} + t_1 = \frac{1}{200} + \frac{1}{300} = \frac{3+2}{600} = \frac{5}{600}\,s$

$u(t_{max} + t_1) = U_m \cdot \sin(\omega(t_{max} + t_1)) = 282 \cdot \sin\left(2 \cdot \pi \cdot f \cdot \frac{5}{600}\right) =$

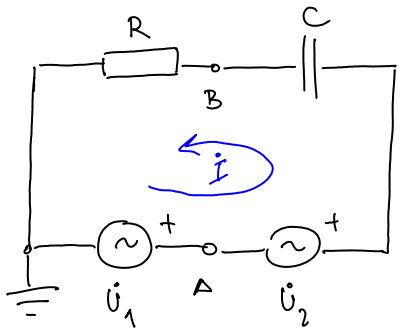
$= 282 \cdot \sin\left(\frac{5}{6}\pi\right) = 282 \cdot 0{,}5 = 141$

$u(t_{max} + t_1) = 141\,V$

Zadatak 2

30. siječnja 2013. 19:43

2.



$\sphericalangle(\dot{U}_1, \dot{U}_{AB}) = 60°$

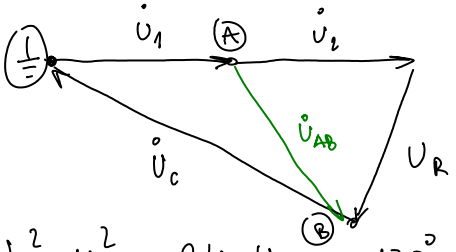
$\omega = 1000\ rad/s$

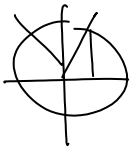
$\dot{U}_1 = \dot{U}_2 = U\angle 0°$

$R = 200\sqrt{3}$

- skica fazorskog dijagrama ($\dot{U}_C$ kasni za $\frac{\pi}{2}$ za $\dot{U}_R$)

(→ zbroj napona = 0, završavaju u istoj točci) da bi kut $\sphericalangle(\dot{U}_1, \dot{U}_{AB})$ bio 60°, mora i kut $\varphi = \sphericalangle(\dot{U}_2, \dot{U}_{AB})$ biti 60°



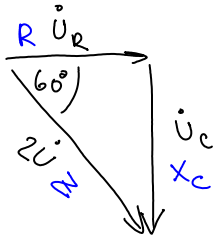


1° $U_C^2 = U_2^2 + U_{AB}^2 - 2U_2 U_{AB}\cos 120° = U^2 + U_{AB}^2 + U\cdot U_{AB}$ | +

2° $U_R^2 = U_1^2 + U_{AB}^2 - 2U_1 U_{AB}\cos 60° = U^2 + U_{AB}^2 - U\cdot U_{AB}$

$U_C^2 + U_R^2 = 2U^2 + 2U_{AB}^2$

$(2U)^2 = 2U^2 + 2U_{AB}^2 \rightarrow U = U_{AB} \rightarrow U_C = \sqrt{3}U,\ U_R = U$



odnosi napona i impedancija su jednaki jer se radi o serijskom spoju, gdje struja kroz svaki element jednaka

$\frac{U_C}{U_R} = \operatorname{tg}\varphi = \frac{X_C}{R} \rightarrow X_C = \frac{U_C}{U_R}\cdot R \rightarrow X_C = \frac{\sqrt{3}U}{U}\cdot 200\sqrt{3} = 600$

$X_C = \frac{1}{\omega C} \Rightarrow C = \frac{1}{\omega X_C} = \frac{1}{1000\cdot 600} = 1{,}67\,\mu F$

$C = 1{,}67\ \mu F$

Zadatak 3

30. siječnja 2013. 20:34

(3.) serija RLC

$R = 50$

$L = 0{,}05\,H$

$C = 20\,\mu F$

$I' = \frac{I}{\sqrt{2}}$

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1. rezonantna frekvencija:

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{20\mu \cdot 0{,}05}} = \frac{1}{10^{-5}} = 10^5\ rad/s$$

$$I = \frac{U}{R} = I = \frac{U}{50}$$

$$\frac{I}{I'} = \sqrt{2} \rightarrow \frac{\frac{U}{R}}{\frac{U}{|Z|}} = \sqrt{2} \Rightarrow \frac{|Z|}{R} = \sqrt{2} \Rightarrow |Z| = \sqrt{2}R \quad /^2$$

$$\Rightarrow R^2 + (X_L - X_C)^2 = 2R^2$$

$$(X_L - X_C)^2 = R^2 \quad / \sqrt{}$$

$$\pm(X_L - X_C) = R \rightarrow \text{kap. karakter} \rightarrow X_C > X_L$$

odabiremo predznak —

$$X_C - X_L = R$$

$$\frac{1}{\omega C} - \omega L = R \quad / \cdot \omega C$$

$$1 - \omega^2 LC = \omega RC \rightarrow \omega^2 LC + \omega RC - 1 = 0$$

$$\omega_{1,2} = \frac{-RC \pm \sqrt{(RC)^2 + 4 \cdot LC}}{2LC} = \frac{-0{,}001 \pm 0{,}00224}{0{,}000002} \cdot 10^6 = \cdot 10^6$$

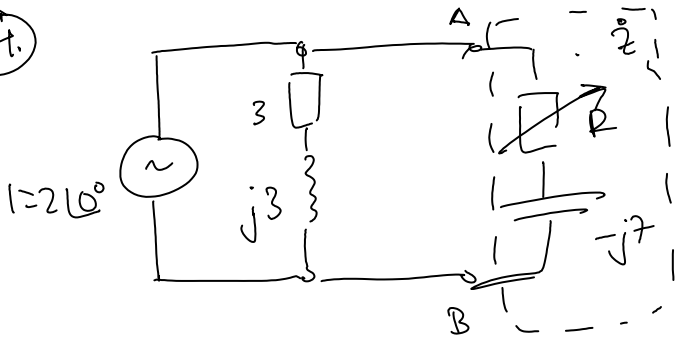
$$= \frac{-1000 \pm 2240}{2} \Rightarrow \{\omega \text{ je mnijek} > 0\} \Rightarrow \omega = \frac{1240}{2} = 620\,s^{-1}$$

$\omega = 619\ rad/s$

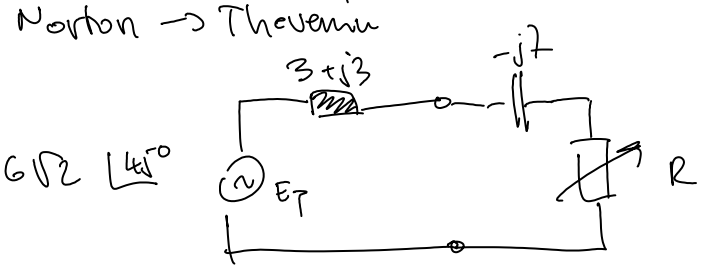
Zadatak 4

30. siječnja 2013. 20:59

4.

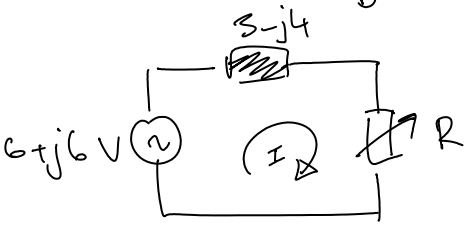


- Norton → Thevenin



$(1+j)^2 = 1^2 + 2j - 1$

$2j$



$$P = I^2 \cdot R = \frac{U^2}{|Z|^2} \cdot R = \left(\frac{6\sqrt{2}}{\sqrt{(3+R)^2+16}}\right)^2 \cdot R = \frac{72R}{(3+R)^2+16}$$

$$\frac{dP}{dR} = 0 = \frac{72\cdot[(3+R)^2+16] - 2(3+R)\cdot 72R}{((3+R)^2+16)^2} \Rightarrow \text{brojnik} = 0$$

$$72(9+6R+R^2+16) - (432R+144R^2) = 0$$

$$1800 + \cancel{432R} + 72R^2 - \cancel{432R} + 144R^2 = 0 \quad |:72$$

$$25 - R^2 \Rightarrow R = 5\,\Omega$$

$$P = \frac{72\cdot 5}{(3+5)^2+16} \Rightarrow$$

P = 4,5 W

Zadatak 5

30. siječnja 2013. 22:00

5. $\left.\begin{aligned} \dot{I} &= 20\angle 30^\circ \\ U &= 120\angle 0^\circ \end{aligned}\right\}$ $\quad \dot{Y} = \frac{1}{20}\angle -30^\circ$

(HINT: zadatak je puno lakše rješavati preko admitancija)

$$\dot{Y} = \frac{1}{20}\angle -18^\circ = \frac{1}{20}\angle -30^\circ + jB_c = \frac{\sqrt{3}}{40} - j\frac{1}{40} + jB_c$$

$$tg(-18^\circ) = \frac{-\frac{1}{40} + B_c}{\frac{\sqrt{3}}{40}} = \frac{-1+40B_c}{\sqrt{3}} \Rightarrow B_c = \frac{\sqrt{3}tg(-18^\circ)+1}{40} = 0{,}011$$

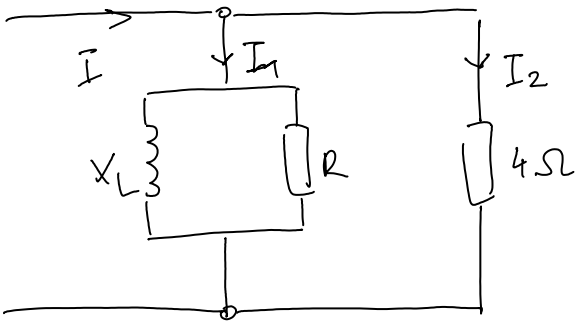
$$B_c = \omega C \Rightarrow C = \frac{0{,}011}{314} = 3{,}48 \cdot 10^{-5}\ F$$

$$C = 34{,}8\ \mu F$$

Zadatak 6

30. siječnja 2013. 22:25

6.



$I_1 = 18A$

$I_2 = 15A$

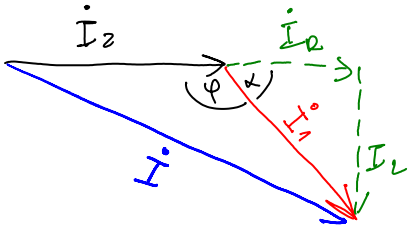
$I = 30A$

$P = ? = I_R^2 \cdot R + I_2^2 (4\Omega)$

$= U \cdot I_2 + U \cdot I_R$

$= U(I_2 + I_R)$

- skica fazorskog dijagrama struja



$I^2 = I_1^2 + I_2^2 - 2 I_1 I_2 \cos\varphi$

$\cos\varphi = \frac{I^2 - I_1^2 - I_2^2}{2 I_1 I_2} = -0{,}65$

$\varphi = 130{,}54°$

$\alpha = 180° - \varphi = 49{,}46°$

$I_R = I_1 \cdot \cos\alpha = 11{,}7$

$U = I_2 \cdot R = 15 \cdot 4 = 60V$

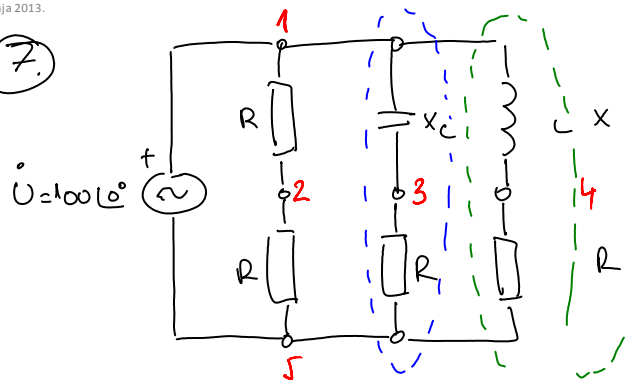
$P = U \cdot I_R + U \cdot I_2 = U(I_2 + I_R) = 60 \cdot (15 + 11{,}7) = 1601{,}98 W$

$P = 1602 W$

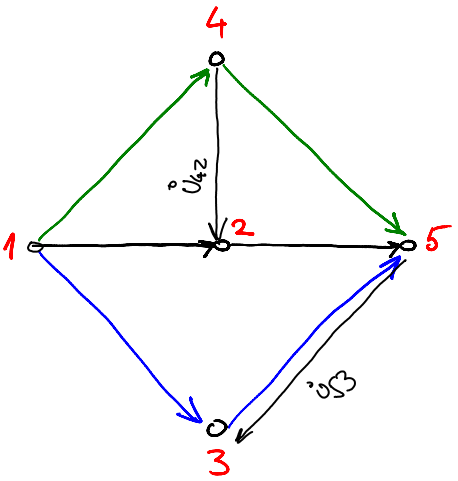
Zadatak 7

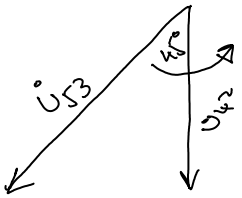
30. siječnja 2013. 22:41

7.



$R = X_L = X_C$





→ $\dot{U}_{42}$ prethodi naponu $\dot{U}_{53}$ za 45°

Zadatak 8

30. siječnja 2013. 22:50

8.

$\dot{Y}_S = \dot{Y}_P$ $\qquad \dot{Z}_S = 10 + j10\ \Omega = 10\sqrt{2}\,\angle 45°$

$\Downarrow$

$Y_S = \frac{1}{10\sqrt{2}}\angle -45° = \frac{1}{20} - j\frac{1}{20} \Rightarrow ?$

$Z_P = R \| jX = \frac{Rj X}{R + jX} \Rightarrow \frac{1}{Z_P} = \frac{R+jX}{jRX} = Y_S = \frac{1-j}{20}$ /

$j \cdot \frac{R+jX}{jRX} = \frac{1-j}{20}$.

$\frac{jR - X}{-RX} = \frac{1-j}{20} \Rightarrow \frac{X - jR}{RX} = \frac{1-j}{20}$ / · 20

$\Rightarrow \frac{20}{R} - j\frac{20}{X} = 1 - j$

realni: $\frac{20}{R} = 1 \Rightarrow R = 20$

imaginarni: $-\frac{20}{X} = -1 \Rightarrow X = 20$

$R = 20\ \Omega$, $X_L = 20\ \Omega$

Zadatak 9

30. siječnja 2013. 23:07

(9.)

$u(t) = 100 \sin(\omega t + \pi) \Rightarrow \dot{U} = 50\sqrt{2}\,\angle 180°$

$i(t) = 1 \cdot \sin(\omega t + \frac{2\pi}{3}) \Rightarrow \dot{I} = \frac{\sqrt{2}}{2}\,\angle 120°$

$\dot{Z} = \frac{\dot{U}}{\dot{I}} = \frac{50\sqrt{2}\,\angle 180°}{\frac{\sqrt{2}}{2}\,\angle 120°} = 100\,\angle 60° = 50 + j50\sqrt{3}$

$\dot{Z}' = 50 + j50\frac{\sqrt{3}}{3} \rightarrow |Z| = \sqrt{50^2 + 50^2 \cdot \frac{1}{3}} = 50\sqrt{\frac{3+1}{3}} = \frac{100}{\sqrt{3}}$

$\rightarrow tg\varphi = \frac{50\frac{\sqrt{3}}{3}}{50} = \frac{\sqrt{3}}{3} \Rightarrow \varphi = 30°$

$\dot{Z}' = \frac{100}{\sqrt{3}}\,\angle 30°$

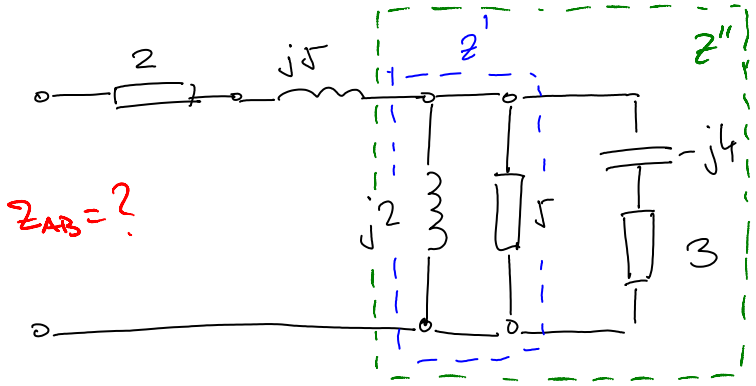
$\dot{I} = \frac{\dot{U}}{\dot{Z}} = \frac{50\sqrt{2}\,\angle 180°}{\frac{100}{\sqrt{3}}\,\angle 30°} = \frac{\sqrt{6}}{2}\,\angle 150°$

$\dot{I} = \frac{\sqrt{6}}{2}\,\angle 150°$

Zadatak 10

30. siječnja 2013. 23:36

10.



$$z' = j2 \parallel \sqrt{} = \frac{j10}{\sqrt{}+j2} \cdot \frac{\sqrt{}-j2}{\sqrt{}-j2} = \frac{20+j\sqrt{}0}{29} = 0,7 + j1,72$$

$$z'' = z' \parallel (3-j4) = \frac{(0,7+j1,72)(3-j4)}{3,7-j2,28} = \frac{8,98+j2,36}{3,7-j2,28} \cdot \frac{3,7+j2,28}{3,7+j2,28} =$$

$$= \frac{27,78+j29,2064}{18,89} = 1,47 + j1,\sqrt{}$$

$$z = 2 + j\sqrt{} + z'' = 3,47 + j6,\sqrt{} \begin{cases} |z| = \sqrt{3,47^2 + 6,\sqrt{}^2} = 7,41 \\ \varphi = \operatorname{arctg}\left(\frac{6,\sqrt{}}{3,47}\right) = 62,1° \end{cases}$$

$$\boxed{Z_{AB} = 7,42 \angle 62,1°}$$