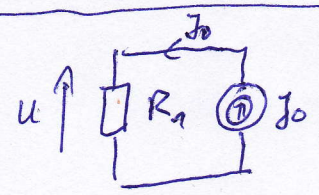
Kolokwium 2, zadanie 2 grupa B

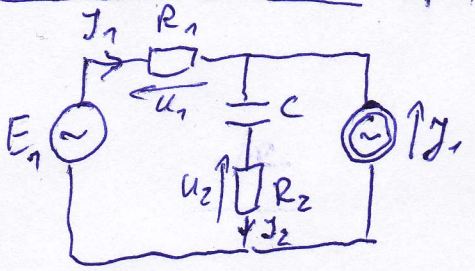
Analiza dla $\omega = 0$ 1 pkt



$P_1^{(0)} = U \cdot J_0 = J_0^2 \cdot R = 8\,mW$

W gałęzi z R_2 znajdują się pojemności i jest rozwarcie dla składowej stałej, zatem $P_2^{(0)} = 0$

Analiza dla $\omega = \omega_0$ 3 pkt



$$P_1^{(1)} = \frac{1}{2} Re\{U_1 \cdot J_1^*\} = \frac{1}{2} |J_1|^2 \cdot R_1$$

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$$\begin{cases} J_2 = J_1 + J_1 \\ E_1 = J_1 R_1 + J_2 \left(\frac{1}{j\omega C} + R_2\right) \end{cases}$$

$$E_1 = J_1 R_1 + (J_1 + J_1)\left(\frac{1}{j\omega C} + R_2\right) \Rightarrow J_1 = \frac{E_1 - J_1\left(R_2 + \frac{1}{j\omega C}\right)}{R_1 + R_2 + \frac{1}{j\omega C}}$$

$$J_1 = \frac{4 - 4\cdot 10^{-3}\left(500 + \frac{1}{j10^6 \cdot 10^{-9}}\right)}{1000 + \frac{1}{j10^6 \cdot 10^{-9}}} = \frac{2 + j4}{1 + j}\,mA = \frac{8 + j2}{2}\,mA = 4 + j1\,mA$$

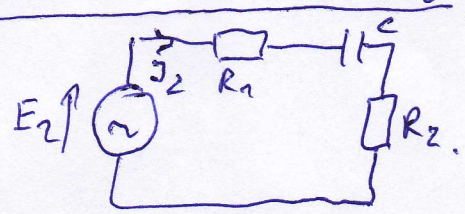
$|J_1| = \sqrt{17}\,mA$

$J_2 = J_1 + J_1 = 4 + j1 + 4 = (8 + j1)\,mA \quad |J_2| = \sqrt{65}$

$P_1^{(1)} = \frac{1}{2}|J_1|^2 \cdot R_1 = \frac{1}{2} \cdot 17 \cdot 500\,\mu W = 4{,}25\,mW$

$P_2^{(1)} = \frac{1}{2} \cdot 65 \cdot 500 = 16{,}25\,mW$

Analiza dla $\omega = 2\omega_0$ 3 pkt



$P_2^{(2)} = \frac{1}{2}|J_2|^2 \cdot R_2 = P_1^{(2)}$ gdyż $R_1 = R_2$

$$J_2 = \frac{E_2}{R_1 + R_2 + \frac{1}{j2\omega_0 C}} = \frac{10}{1000 + \frac{1}{j2 \cdot 10^6 \cdot 10^{-9}}} = \frac{10}{1000 + j500} = \frac{20}{2 + j} \cdot 10^{-3} = \frac{40 + 20j}{5} \cdot 10^{-3} =$$

$= 8 + j4\,mA$

$|J_2| = \sqrt{64 + 16} = \sqrt{80}$

$P_1^{(2)} = P_2^{(2)} = \frac{1}{2} \cdot 80 \cdot 500\,\mu W = 20\,mW$

Odp:

$P_1 = 8\,mW + 4{,}25\,mW + 20\,mW = 32{,}25\,mW$

$P_2 = 16{,}25\,mW + 20\,mW = 36{,}25\,mW.$