task_pdkggtyexxy1ktu3_with_calculation

Student Group

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complex impedance, exam ee1 WS2022

Exercise E8 Impedances at different Frequencies
(written test, approx. 18 % of a 60-minute written test, WS2022)

[illegible] ~\rm A$ through R_3.
Result: [illegible]

1. A resistor R_1 shall have the same absolute value of the impedance as a capacitor $C_1=40 ~{\rm nF}$ at $f_1=4 ~{\rm MHz}$.

Solution

Solution \begin{align*} R_1 &= 1.00 ~\Omega \\ \end{align*}

Solution \begin{align*} [illegible] ~\Omega \\ \end{align*}

A series circuit means that the current is constant on every component.

The equivalent impedance for R and L combined is given by \begin{align*} [illegible]

Parallel circuit means that the voltage is the same on R_3 and C_3.

[illegible] (It has to, since R_3 is perpendicular to ${\rm j}\cdot {X}_{3C}$, too).

Therefore, the resulting current of the parallel circuit is given as: \begin{align*} \underline{I}_{3} &= \underline{I}_{3R} + \underline{I}_{3C} \\ [illegible]

[illegible] \right)^2 - (2\pi \cdot 450~{\rm kHz} \cdot 4.7 ~ {\rm µH})^2 } \\ \end{align*}

Back to the first formula: \begin{align*} R_3 \cdot {I}_{3R} &= {X}_{3C} \cdot {I}_{3C} \\ R_3 &= {X}_{3C} \cdot {{{I}_{3C}}\over{{I}_{3R}}} \\ &= {{1}\over{2\pi \cdot f \cdot C_3}} \cdot {{\sqrt{|{I}_{3}|^2 - |{I}_{3R}|^2}}\over{{I}_{3R}}} \\ \end{align*}