task_uzbbnoz8abe6201d_with_calculation

Student Group

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exam ee1 SS2023

Exercise E3 Impedances at Frequencies
(written test, approx. 14 % of a 60-minute written test, SS2023)

At which frequency f_2 do the following impedances have the same value?
Results are rounded to 3 significant digits.
1. An inductor with $X_{L1} = 60 ~\rm m\Omega$ and $L_1 = 15.9 ~\rm \mu H$.

Solution
Solution

\begin{align*} f_2 &= 3.77 ~\rm MHz \\ \Rightarrow f_2 &= 3.77 ~\rm MHz \end{align*}
kHz}\end{align*}

\begin{align*} X_{L2} &= X_{C2} \\ \omega_2 \cdot L_2 &= \frac{1}{\omega_2 \cdot C_2} \\ 2 \cdot C_2} &= \frac{1}{4\pi^2 f_2^2 \cdot L_2} \\ \Rightarrow f_2 &= \frac{1}{2\pi \sqrt{L_2 \cdot C_2}} \\ &= \frac{1}{2\pi \sqrt{15.9 \cdot 10^{-6} ~\rm H \cdot 5.6 \cdot 10^{-9} ~\rm F}} \\ &= 3.77 ~\rm MHz \end{align*}

\begin{align*} X_{L1} &= \omega_1 \cdot L_1 = 2\pi f_1 \cdot L_1 \\ \Rightarrow f_1 &= \frac{X_{L1}}{2\pi \cdot L_1} \\ &= \frac{60 ~\rm m\Omega}{2\pi \cdot 15.9 \cdot 10^{-6} ~\rm H} \\ &= \frac{60 \cdot 10^{-3} ~\rm \frac{V}{A}}{2\pi \cdot 15.9 \cdot 10^{-6} ~\rm \frac{Vs}{A}} \\ &= 600 ~\rm Hz \end{align*}