task_c9fj1si7l797equs_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

impedance, phasor, cutoff, exam ee1 SS2023

Exercise E11 Complex voltage dividers
(written test, approx. 16 % of a 60-minute written test, SS2023)

~~3. Calculate the impedance $\underline{Z}_L$ of the coil.~~
~~4. Calculate the voltage $\underline{U}_\rm O$ resulting from the superposition of the two voltages.~~
~~5. Draw the resulting phasor diagram for the voltages $\underline{U}_\rm I$, $\underline{U}_\rm O$ and $\underline{U}_R$.~~
~~Result~~
~~Choose an appropriate scaling~~

Solution

Solution

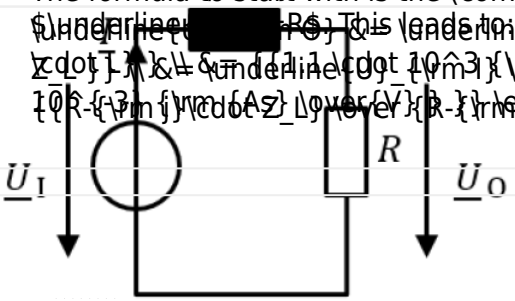
- $R = 1.1 ~\rm k\Omega$
- $L = 3.5 ~\rm mH$
- $\underline{U}_\rm I = 5 ~\rm V$

\begin{align*} \underline{Z}_L &= {\rm j} \cdot \omega \cdot L \\ &= {\rm j} \cdot 2\pi \cdot 150 ~\rm kHz \cdot 3.5 ~\rm mH \\ &= {\rm j} \cdot 3300 ~\Omega \end{align*}

\begin{align*} \underline{U}_{\rm O} &= 0.5 ~\rm V - j \cdot 1.5 ~V \end{align*}

The formula to start with is the (complex) voltage divider: \begin{align*} \underline{U}_{\rm O} &= \underline{U}_{\rm I} \cdot {R} \over {R + {\rm j} \cdot Z_L } \end{align*}

At cut off frequency the absolute values of impedances $\underline{Z}_L$ is equal to $\underline{R}$. This leads to: \begin{align*} f_{\rm cutoff} &= {R} \over {2\pi \cdot L} \\ &= {1.1 \cdot 10^3 {\rm V} \over A} } \over {2\pi \cdot 3.5 \cdot 10^{-3} {\rm As} \over {\rm V} } } \end{align*}



1. Calculate the impedance $\underline{Z}_L$.

Solution

\begin{align*} \underline{Z}_L &= {\rm j} \cdot \omega \cdot L \\ &= {\rm j} \cdot 2\pi \cdot 150 ~\rm kHz \cdot 3.5 ~\rm mH \end{align*}