task_c9fj1si7l797equs_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

impedance, phasor, cutoff, exam ee1 SS2023

Exercise E3 Complex voltage dividers
(written test, approx. 16 % of a 60-minute written test, SS2023)

The circuit ... $\underline{U}_\rm O$ and $\underline{U}_\rm I$ ... **Choose an appropriate scaling factor** and write it down.

- $R = 1.1 ~\rm k\Omega$
- $L = 3.5 ~\rm mH$
- $\underline{U}_\rm I = 5 ~\rm V$
- $f = 150 ~\rm kHz$

Result

$$\underline{Z}_L = 3.3 ~\rm k\Omega$$

$$\underline{U}_{\rm O} = 0.5 ~\rm V - j \cdot 1.5 ~V$$

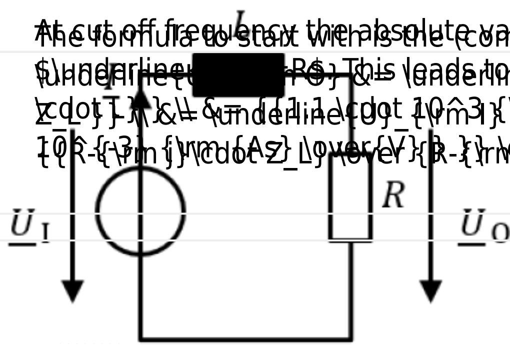
Solution

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

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

Result

$$f_{\rm cutoff} = 50 ~\rm kHz$$



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

Solution

$$\underline{Z}_L = {\rm j} \cdot \omega \cdot L = {\rm j} \cdot 2\pi \cdot 150 ~\rm kHz \cdot 3.5 ~\rm mH$$