

task_7el8zljglaazxtw_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E1 Series Resonant Circuit (written test, approx. 10 % of a 120-minute written test, SS2022)	2
---	---

resonant circuit, exam ee2 SS2022

Exercise E1 Series Resonant Circuit
(written test, approx. 10 % of a 120-minute written test, SS2022)

2. What is the resonance frequency of a series resonant circuit with an inductor of inductance L and a capacitor of capacitance C ?

At this resonance frequency, the impedance of the circuit would be X_{RLC} . Which value would C have for the given f_0 ?

Path: $C = 10 \text{ nF}$

$R = 88.6 \text{ m}\Omega$

Path: $L = 60 \text{ pH}$

$X_{RLC} = 255.5 \text{ m}\Omega$

$X_{LC} = 88.6 \text{ m}\Omega$

The resonance frequency is given as $f_0 = \frac{1}{2\pi\sqrt{LC}}$

That is, $L = \frac{1}{(2\pi f_0)^2 C}$

$X_{RLC} = R$ at resonance

$X_{RLC} = X_L + X_C = j\omega L - \frac{j}{\omega C}$

At resonance, the impedance is purely real.

With values: $C = \frac{1}{2\pi \cdot 100 \cdot 10^6 \cdot 10.6 \cdot 10^{-9}}$

1. What is the impedance Z_{RLC} of this real capacitor for $f_0 = 100 \text{ MHz}$? (Phase and magnitude)

Path

The impedance Z_{RLC} is given by:

$$Z_{RLC} = R + j\omega L - \frac{j}{\omega C} = R + j(\omega L - \frac{1}{\omega C})$$

Putting in the numbers, only for the reactive part X_{LC} :

$$X_{LC} = 2\pi \cdot 100 \cdot 10^6 \cdot 10 \cdot 10^{-9} - \frac{1}{2\pi \cdot 100 \cdot 10^6 \cdot 10 \cdot 10^{-9}}$$

$$X_{LC} = -121.45 \text{ m}\Omega$$

With the real and imaginary parts, we can derive the magnitude and phase:

$$\begin{aligned} X_{\text{RLC}} &= \sqrt{R^2 + \{X\}_{\text{LC}}^2} \quad \&= \sqrt{(88 \sim\text{m}\Omega)^2 + (-121.45 \sim\text{m}\Omega)^2} \quad \&= 150.0... \sim\text{m}\Omega \\ \end{aligned}$$

$$\begin{aligned} \varphi &= \arctan \left(\frac{\{X\}_{\text{LC}}}{R} \right) \quad \&= \arctan \left(\frac{-121.45 \sim\text{m}\Omega}{88 \sim\text{m}\Omega} \right) \quad \&= -0.9437... \\ &= -54.07...^\circ \quad \end{aligned}$$

From:

<https://wiki.mexle.org/> - **MEXLE Wiki**

Permanent link:

https://wiki.mexle.org/ee2/task_7e18zljglaazxtw_with_calculation?rev=1720138686

Last update: **2024/07/05 02:18**

