

task_kricv9fh7haauo6q_with_calculation

Student Group

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complex impedance, exam ee1 WS2022

Exercise E14 Complex Impedance Circuit (written test, approx. 15 % of a 60-minute written test, WS2022)

2. Calculate the circuit impedance Z for the signal $u(t) = 3.0 \cdot \sin(2\pi \cdot 15 \cdot t)$ V. The circuit consists of an AC voltage source $u(t) = 3.0 \cdot \sin(2\pi \cdot 15 \cdot t)$ V, a resistor of 10Ω , an inductor of $330 \mu\text{H}$, and a capacitor of $0.22 \mu\text{F}$, all in series.

Solution: The circuit impedance Z is the sum of the individual impedances: $Z = R + j\omega L - j\omega C$. Substituting the given values, we get $Z = 10 \Omega + j(2\pi \cdot 15 \cdot 330 \cdot 10^{-6}) \Omega - j(2\pi \cdot 15 \cdot 0.22 \cdot 10^{-6}) \Omega$.

Result: $Z = 10 \Omega + j0.31 \Omega - j0.66 \Omega = 10 \Omega - j0.35 \Omega$. The magnitude of the impedance is $|Z| = \sqrt{10^2 + (-0.35)^2} \approx 10.01 \Omega$.

Draw the circuit diagram of the given circuit and label all components, voltages, and currents.

$$Z = \frac{U}{I} \quad I = \frac{U}{Z} \quad Z_C = \frac{1}{2\pi \cdot f \cdot C} \quad \omega = 2\pi \cdot f \cdot C$$

$$Z_L = 2\pi \cdot f \cdot L \quad \omega = 2\pi \cdot f \cdot L$$

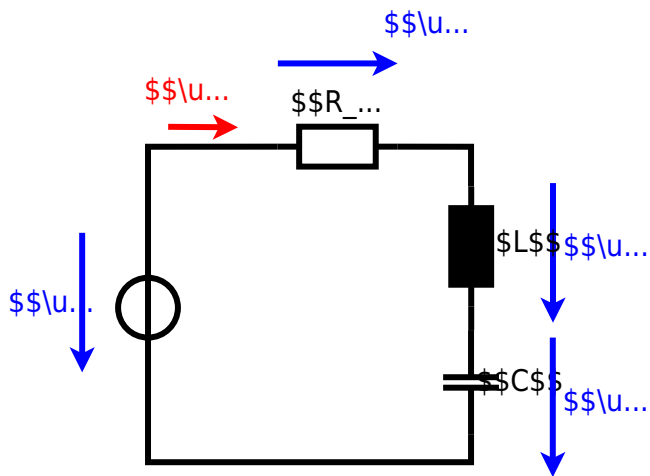
$$Z = R + jZ_L - jZ_C = R + j(2\pi \cdot f \cdot L - 2\pi \cdot f \cdot C)$$

$$Z = 10 \Omega + j(2\pi \cdot 15 \cdot 330 \cdot 10^{-6}) \Omega - j(2\pi \cdot 15 \cdot 0.22 \cdot 10^{-6}) \Omega$$

$$\underline{Z} = R + \underline{Z}_L + \underline{Z}_C = R + j \cdot \omega L - j \cdot \omega C$$

$$\underline{Z} = R + j(\omega L - \omega C) \quad |\underline{Z}| = \sqrt{R^2 + (\omega L - \omega C)^2}$$





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