

task_kricv9fh7haauo6q_with_calculation

Student Group

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Exercise E1 Complex Impedance Circuit**(written test, approx. 15 % of a 60-minute written test, WS2022)**

1. Calculate the complex impedance $\underline{Z}$ of the circuit shown in the figure. The voltage source $u(t) = 3.0 \cdot \sin(2\pi \cdot 15 \cdot 10^3 t) \text{ V}$ is connected in series with an inductor of $330 \text{ } \mu\text{H}$ and a capacitor of $0.22 \text{ } \mu\text{F}$.

Solution
The linear source is connected with an inductor of $330 \text{ } \mu\text{H}$ and a capacitor of $0.22 \text{ } \mu\text{F}$, all in series.

Result
 $\underline{Z} = 19.8 - j48.2 \text{ } \Omega$

Draw the circuit diagram of the given circuit.

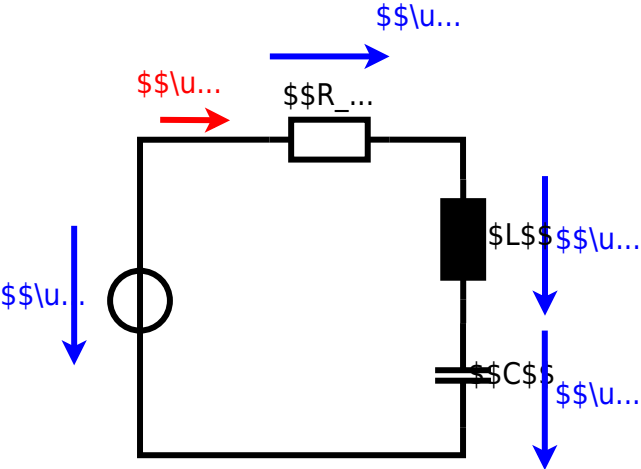
Solution
The circuit diagram of the given circuit is shown below. The voltage source $u(t) = 3.0 \cdot \sin(2\pi \cdot 15 \cdot 10^3 t) \text{ V}$ is connected in series with an inductor of $330 \text{ } \mu\text{H}$ and a capacitor of $0.22 \text{ } \mu\text{F}$.

Result
The complex impedance $\underline{Z}$ of the circuit is calculated as follows:
$$\underline{Z} = \underline{Z}_L + \underline{Z}_C$$

where $\underline{Z}_L = j\omega L$ and $\underline{Z}_C = -j/\omega C$.
With $\omega = 2\pi \cdot 15 \cdot 10^3 \text{ rad/s}$, $L = 330 \text{ } \mu\text{H}$, and $C = 0.22 \text{ } \mu\text{F}$, we get:
$$\underline{Z}_L = j\omega L = j \cdot 2\pi \cdot 15 \cdot 10^3 \cdot 330 \cdot 10^{-6} = j48.2 \text{ } \Omega$$

$$\underline{Z}_C = -j/\omega C = -j / (2\pi \cdot 15 \cdot 10^3 \cdot 0.22 \cdot 10^{-6}) = -j19.8 \text{ } \Omega$$

Therefore, the total complex impedance is:
$$\underline{Z} = j48.2 - j19.8 = j28.4 \text{ } \Omega$$



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