task_jti0uzudcmg4u22t_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

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complex impedance, exam ee1 WS2022

Exercise E1.1 Analyzing complex Impedances
(written test, approx. 14 % of a 60-minute written test, WS2022)

$$\begin{aligned} \underline{I} &= \frac{\underline{U}}{\underline{Z}} \\ &= \frac{50\ \mathrm{V}}{0.24\ \Omega + \mathrm{j} \cdot 4.68\ \Omega} \\ &= \frac{50\ \mathrm{V}}{0.24\ \Omega + \mathrm{j} \cdot 4.68\ \Omega} \cdot \frac{0.24\ \Omega - \mathrm{j} \cdot 4.68\ \Omega}{0.24\ \Omega - \mathrm{j} \cdot 4.68\ \Omega} \\ &= \frac{12\ \Omega - \mathrm{j} \cdot 234\ \Omega}{0.24^2\ \Omega^2 + 4.68^2\ \Omega^2} \\ &= \frac{12 - \mathrm{j} \cdot 234}{21.9} \mathrm{A} \\ &= 0.55 - \mathrm{j} \cdot 10.7\ \mathrm{A} \end{aligned}$$

$$\begin{aligned} \underline{Z} &= \left(\frac{2}{3+4\mathrm{j}}+5\mathrm{j}\right)\Omega \\ &= \left(\frac{2}{3+4\mathrm{j}} \cdot \frac{3-4\mathrm{j}}{3-4\mathrm{j}} + 5\mathrm{j}\right)\Omega \\ &= \left(\frac{2}{9+16} \cdot (3-4\mathrm{j}) + 5\mathrm{j}\right)\Omega \\ &= \left(0.24 - \mathrm{j} \cdot 0.32 + 5\mathrm{j}\right)\Omega \\ &= 0.24\ \Omega + \mathrm{j} \cdot 4.68\ \Omega \end{aligned}$$

$$\begin{aligned} |\underline{Z}| &= \sqrt{\Re{\underline{Z}}^2 + \Im{\underline{Z}}^2} \\ &= \sqrt{(0.24\ \Omega)^2 + (4.68\ \Omega)^2} \end{aligned}$$

$$\begin{aligned} X_L &= \omega \cdot L \\ &= 2\pi \cdot f \cdot L \\ &= 2\pi \cdot 300\ \mathrm{Hz} \cdot 4.68\ \Omega \end{aligned}$$

$$\begin{aligned} \varphi_i &= \arctan\left(\frac{\Im()}{\Re()}\right) \\ &= \arctan\left(\frac{-4.68\ \Omega}{0.24\ \Omega}\right) \end{aligned}$$