

task_d9io924n0e3du21g_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

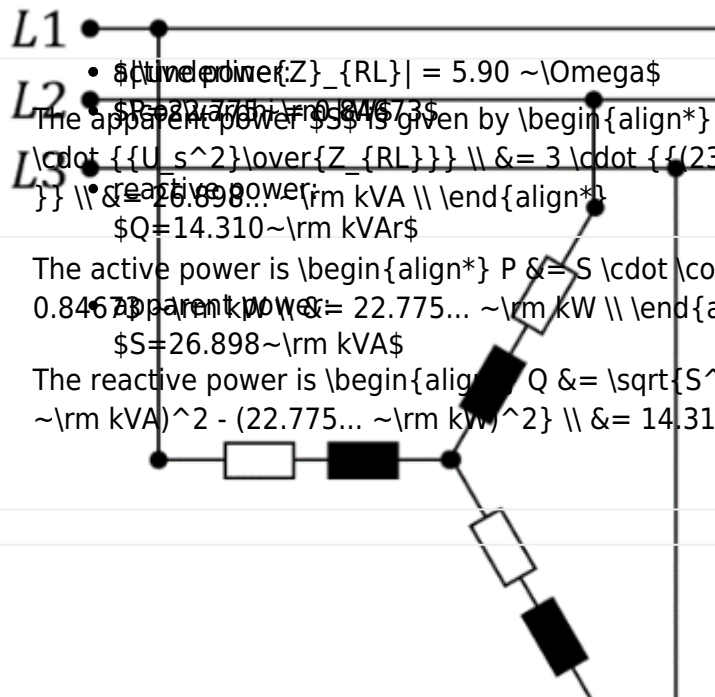
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resonance, impedance, resonant circuit, exam ee2 SS2024

Exercise E6 Magnetic Circuit**(written test, approx. 10 % of a 120-minute written test, SS2024)**

2. Calculate the real power, the apparent power, and the phase angle of the three-phase power net. Each single string has a resistor $R=5 \sim \Omega$ and an inductance of $L=10 \sim \text{mH}$.
Path



$|Z_{RL}| = 5.90 \sim \Omega$
 $R=5 \sim \Omega$
 $L=10 \sim \text{mH}$
 $f=50 \sim \text{Hz}$
 $U_s = 230 \sim \text{V}$
 $I_s = 38.14 \sim \text{A}$
 $\cos \varphi = 0.84673$
 $\varphi = 32.00^\circ$
 $P = 26.898 \sim \text{kW}$
 $Q = 14.310 \sim \text{kVar}$
 $S = 29.949 \sim \text{kVA}$

The apparent power S is given by
$$S = 3 \cdot U_s \cdot I_s = 3 \cdot \frac{U_s^2}{|Z_{RL}|} = 3 \cdot \frac{(230 \sim \text{V})^2}{5.90 \sim \Omega} = 29.949 \sim \text{kVA}$$

The active power is
$$P = S \cdot \cos \varphi = 29.949 \sim \text{kVA} \cdot 0.84673 = 25.36 \sim \text{kW}$$

The reactive power is
$$Q = \sqrt{S^2 - P^2} = \sqrt{(29.949 \sim \text{kVA})^2 - (25.36 \sim \text{kW})^2} = 14.310 \sim \text{kVar}$$

1. Calculate the $\cos \varphi$, and the magnitude of the impedance $|Z|$ for a single string.

Path

The phase φ is given by:
$$\varphi = \arctan \left(\frac{X_L}{R} \right) = \arctan \left(\frac{2\pi \cdot f \cdot L}{R} \right) = \arctan \left(\frac{2\pi \cdot 50 \sim \text{Hz} \cdot 10 \cdot 10^{-3} \sim \text{H}}{5 \sim \Omega} \right) = 0.5609 \dots \hat{=} +32^\circ$$

With this, the $\cos \varphi$ becomes
$$\cos \varphi = \cos(0.5609 \dots) = 0.84673 \dots$$

The impedance is given by:
$$|Z_{RL}| = \sqrt{X_L^2 + R^2} = \sqrt{(2\pi \cdot f \cdot L)^2 + R^2} = \sqrt{(2\pi \cdot 50 \sim \text{Hz} \cdot 10 \cdot 10^{-3} \sim \text{H})^2 + (5 \sim \Omega)^2} = 5.905 \dots \sim \Omega$$

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