

task_ezrkjzifcegttcpc_with_calculation

Student Group

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Table of Contents

Exercise E19 Multiphase systems (written test, approx. 4 % of a 120-minute written test, SS2021) 2

Multiphase systems, RMS, power, exam ee2 SS2021

Exercise E19 Multiphase systems (written test, approx. 4 % of a 120-minute written test, SS2021)

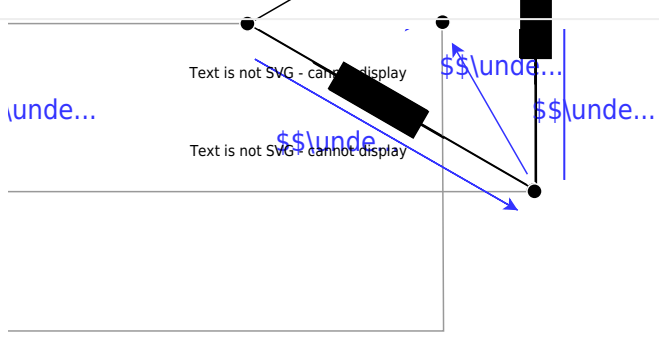
a) Specify the RMS value of the phase voltage U_{ph} and the RMS value of the line voltage U_{L} . Resulting.

A voltage with the RMS value $U_{\text{RMS}} = 110 \text{ V}$ is applied between the terminals of each winding.

Through each of the windings, there is a current with an RMS value $I_{\text{RMS}} = 5 \text{ A}$ and a phase shift $\varphi = \pm 25^\circ$ compared to the voltage.

b) Draw the circuit diagram. Since $U_{\text{ph}} = 110 \text{ V}$ and $I_{\text{RMS}} = 5 \text{ A}$ is applied through each winding, the active power P in each winding is $P = U_{\text{ph}} \cdot I_{\text{RMS}} \cdot \cos(\varphi)$. For a three-phase system, the total active power is $P_{\text{total}} = 3 \cdot P = 3 \cdot 110 \cdot 5 \cdot \cos(25^\circ) \approx 1610.88 \text{ W}$. The reactive power Q in each winding is $Q = U_{\text{ph}} \cdot I_{\text{RMS}} \cdot \sin(\varphi)$. For a three-phase system, the total reactive power is $Q_{\text{total}} = 3 \cdot Q = 3 \cdot 110 \cdot 5 \cdot \sin(25^\circ) \approx 1361.88 \text{ var}$. The complex power S in each winding is $S = U_{\text{ph}} \cdot I_{\text{RMS}} \cdot e^{j\varphi}$. For a three-phase system, the total complex power is $S_{\text{total}} = 3 \cdot S = 1610.88 \text{ W} + j1361.88 \text{ var}$. The real power must be zero: $\sum P_i = 0$.

By this (and showing in the example in the image below), One can see, that $I_{\text{L}} = \sqrt{3} \cdot I_{\text{RMS}} = \sqrt{3} \cdot 5 \text{ A}$



one single phase as an example



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