task_ezrkjzifcegttcpc_with_calculation

Student Group

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resonance, resonant circuit, RMS, power, exam ee2 SS2021

Exercise E1 Resonant Circuit
(written test, approx. 4 % of a 120-minute written test, SS2021)

~~Specify the RMS value of the phase voltage $U_{\rm S}$ and the string voltage $U_{\rm S}$.~~
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shall be considered in the following.

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

Through each of the windings, there is a current with an RMS value $I_{\rm RMS} = 5 ~\rm A$ and a phase shift of $\varphi = +25°$ compared to the voltage.

- $U_{\rm RMS}=110~\rm V$
- $U_{\rm RMS}=110~\rm V$
- $U_{\rm RMS}=110~\rm V$
- $I_{\rm RMS}=5~\rm A$
- $I_{\rm RMS}=5~\rm A$
- $I_{\rm RMS}=5~\rm A$

Since the windings are connected in star, $U_{\rm RMS}=110~\rm V$ is applied between each of the terminals and the star point. This is also the string voltage $U_{\rm S}$.

The active power P is given by: $P = 3 \cdot U \cdot I \cdot \sin(\varphi)$

For the given values, the following applies: $P = 3 \cdot 110~\rm V \cdot 5~\rm A \cdot \sin(25°) = 1610.888...~\rm W$

a) Draw the circuit diagram.

Result

Path

$W = 1.61~\rm kW$

$U_{\rm RMS}=110~\rm V$

$U_{\rm RMS}=110~\rm V$

$U_{\rm RMS}=110~\rm V$

$I_{\rm RMS}=5~\rm A$

$I_{\rm RMS}=5~\rm A$

$I_{\rm RMS}=5~\rm A$

$U_{\rm S}$

$U_{\rm S}$

$U_{\rm S}$

For the star connection, the line voltage $U_{\rm L}$ is $\sqrt{3}$ times the string voltage $U_{\rm S}$.

$U_{\rm L} = \sqrt{3} \cdot U_{\rm S} = \sqrt{3} \cdot 110~\rm V = 190.525...~\rm V$

Result

For all star connections, the sum of the line currents must be zero: $\sum I_i = 0$.

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