Exercise week #3
Balanced load in a three-phase system

Problem 1 (in class):

Consider the electronic circuit shown in Fig. 1. It represents a balanced load for a three-phase power system where each impedance $\underline{Z}$ consists of a resistor and an inductor connected in series with the following parameters:

$f = 50$ Hz, $U_l = 400$ V, $R = 50\ \Omega$ and $\omega \cdot L = 50\ \Omega$.

a) Calculate the effective values of the line currents I_R, I_S, I_T.

b) Calculate the dephasing of the current with respect to the associated phase voltage $\angle(\underline{I}_R, \underline{U}_{RN})$, $\angle(\underline{I}_s, \underline{U}_{SN})$, $\angle(\underline{I}_T, \underline{U}_{TN})$.

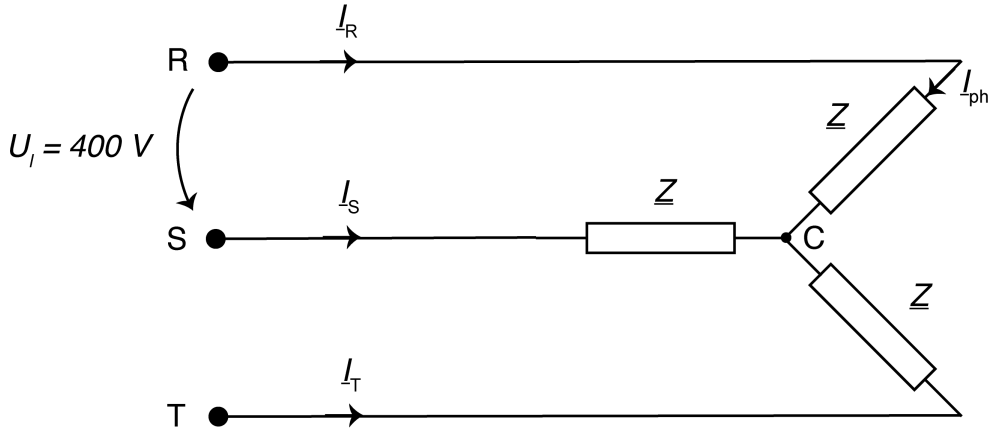

Figure 1: Electronic circuit.

Problem 2 (self-study):

Consider the electronic circuit shown in Fig. 2 with $\alpha \neq 0$ and $U_l = 400$ V. The load is supposed to be balanced with $\underline{Z}_1 = \underline{Z}_2 = \underline{Z}_3 = R$, but when measuring the current on the neutral, it turns out that the current is non-zero, $\underline{I}_N = I_N e^{j\phi_N}$. After some tests, we find that there must be something wrong with $\underline{Z}_3$ and that it carries an undesired reactive component, hence $\underline{Z}_3 = R + jX$. Given the following parameters: $f = 50$ Hz, $U_l = 400$ V, $R = 50\ \Omega$, $I_N = 1$ A and $\phi_N = -107°$.

a) Calculate X and find the lumped element by which it is caused.

b) You now want to correct this imbalance and balance the system again by either replacing the lumped elements in the R-branch or, alternatively, in the S-branch with new components. Which lumped element would you choose for either of the two branches?

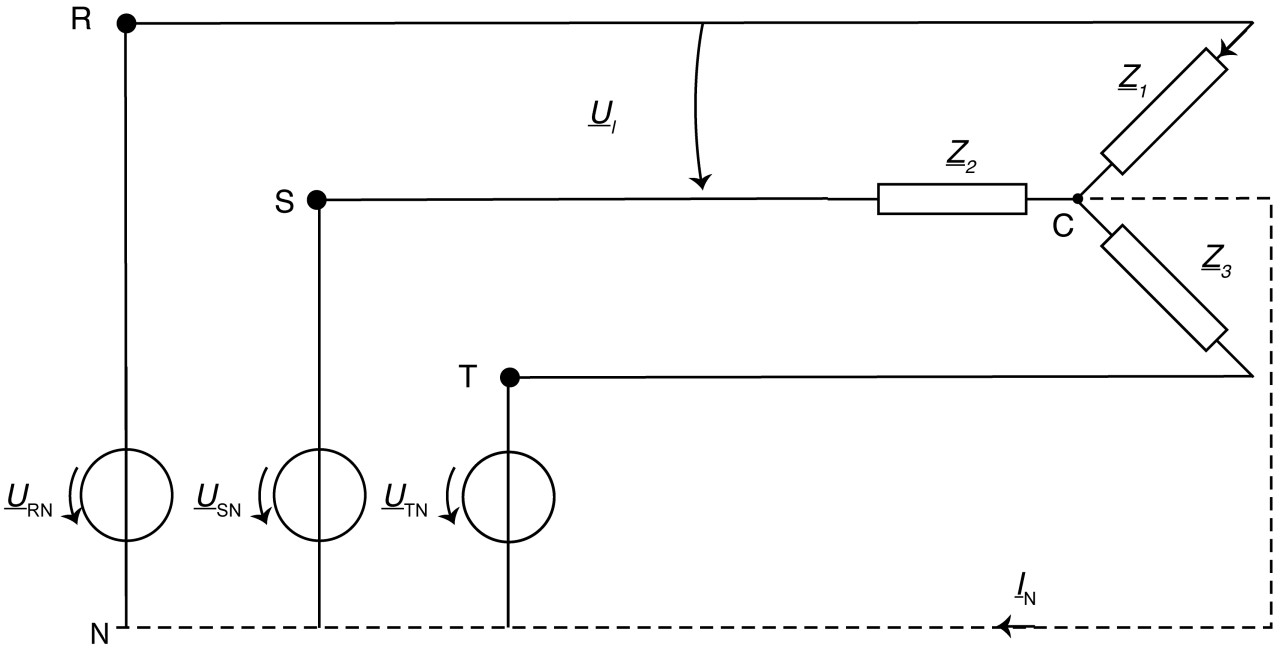

Figure 2: Electronic circuit.