ELEC 0041: Homework 3 - due on May 20, 2022

You are asked to design a three-phase 50 Hz transformer with a primary voltage of 2.4 kV, a secondary voltage of 240 V and a nominal power 200 kVA.

The windings are to be designed for allowing reasonable Joule losses, to achieve good overall efficiency. The magnetic core should be designed to avoid the full saturation of the chosen magnetic material (which typically arises for magnetic flux densities around 1.8–2 T). Parameterized studies are to be performed to point out the effect of the winding electric resistivity, the core magnetic permeability and the possible presence of an air gap.

You should perform numerical tests to determine the lump parameter equivalent circuit of the transformer using open and short circuit tests (see e.g. http://www.montefiore.ulg.ac.be/~geuzaine/ELEC0431/2_Transformer.pdf), and to compute the transformer exterior characteristic for resistive, inductive and capacitive loads. The effect of harmonics should be investigated as well.

Bonus points will be awarded if the linear frequency-domain models are extended to non-linear, time-domain models, with a realistic saturation curve for the core.

By groups of two students, write a max. 10 page report (additional pages with figures and/or tables are allowed) where you present and comment your results. Send your report by email to `cgeuzaine@uliege.be` in PDF format together with your model files, bundled in a single `.zip` file. The file should be named: `hw3_lastname1_lastname2.zip`.