ELEC 0041: Homework 3 - due on May 5, 2020

You are asked to design two three-phase 50 Hz transformers:

- Type A: primary voltage 2.4 kV, secondary voltage 240 V, nominal power 200 kVA;

- Type B: primary voltage 60 kV, secondary voltage 2.4 kV, nominal power 20 MVA.

You should perform numerical tests to determine their equivalent circuits (using open and short circuit tests: see e.g. http://www.montefiore.ulg.ac.be/~geuzaine/ELEC0431/2_Transformer.pdf), and compute their exterior characteristic.

The windings are to be designed for allowing reasonable Joule losses. The magnetic core is to be designed for allowing the magnetic flux density to be lower than the saturation induction of the chosen magnetic material (typically around 1.8–2 T); core- or shell-type designs should be compared. Additional parameterized studies are to be done to point out the effect of the winding electric resistivity, the core magnetic permeability and the possible presence of an air gap.

Other studies showing the effect of a non-laminated core, the effect of a tank/shield surrounding the transformer, the effect of higher operating frequencies and the loss of one phase could be performed as well.

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

By groups of 2, write a max. 25 page report 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.