HOMEWORK # 1 - February 11, 2020

Consider the 6-bus network from the lecture "Power flow computation and sensitivity analysis in a simple system".

Work in per unit on the 100-MVA base power.

1. Assume all transformer ratios are real (no phase shift; as in slide # 9).
   (a) Assemble and solve the equations of the system *under the DC approximation*.
   (b) Compute the corresponding active power flows in line B-C, line D-E, transformer C-E and transformer F-B.
   (c) Compare with the values obtained with the non-simplified power flow computation (see slide # 9). Comment on accuracy.

2. Assume that transformer X is equipped with a phase shifting device, modeled by a complex transformer ratio $\overline{n} = 1\angle\phi$.
   (a) Adjust correspondingly the equations of Item 1.
   (b) Determine the variation with ϕ of the power flows in line B-C, line D-E and transformer B-D.
   (c) Compare with the variations obtained with the non-simplified power flow computation (see slide # 12). Comment on accuracy.

3. Power flow control: determine the value of ϕ that makes the branches Y and Z equally loaded, i.e.

$$\frac{|\,\text{P in branch Y (MW)}\,|}{\text{Snom of branch Y (MVA)}} = \frac{|\,\text{P in branch Z (MW)}\,|}{\text{Snom of branch Z (MVA)}}$$

Extend the formulation of Item 2 in order to obtain the value of ϕ *directly*, together with the phase angles θ_i.

- Variants :

group #	transformer X	branch Y	branch Z
1	D-B	line B-C	line D-E
2	E-C	line B-C	line D-E
3	D-B	transfo B-D	transfo C-E

- Each group writes down and e-mail to me (t.vancutsem@ulg.ac.be) a report in PDF format no later than **February 26 at noon**
- On March 3 (lecture # 4), you will be asked to present your results. Your PDF files will be available for projection.

- Use Matlab and append your Matlab code to the report.
  This is no substitute to the report; it is to check your derivations in case of problem...