HOMEWORK # 2 - March 3, 2020

1. Show that in a synchronous machine, the phasor $\bar{V} + R\bar{I} + jX_q\bar{I}$ is aligned along the q axis of the machine.

2. A salient-pole synchronous machine has a nominal apparent power of 300 MVA and the following parameters :
   $X_d = 1.45 \quad X_q = 0.89 \quad R_a = 0.0065$, in per unit on the 300-MVA base.

   Let i_f^o be the field current when the machine rotates at its nominal speed, with the stator opened, and a terminal voltage of 1 pu.

   Let i_f be the field current when the machine operates at its nominal speed, at the values of P, Q and V given in the table below.

group	V (pu)	P (MW)	Q (Mvar)
Master EM	1.00	270	100
Master EL	0.95	285	50

   Compute the ratio i_f / i_f^o.

   Hint. Use Item ① to determine θ_r^o.

3. Which mechanical power P_m is produced by the turbine (in MW) ?

4. *(Question for Master EL only)*
   Use the formulae of slide # 33 (in per unit) to compute E_q and δ. Compare with the values obtained at Item ②.

5. Consider the system of the lecture "Behaviour of synchronous machine during a short-circuit".
   Using a simple equivalent circuit (constant emf behind equivalent reactance) of the machine compute :

group	
Master EL	the current in the machine (in pu)
Master EM	the terminal voltage of the machine (in pu)

   at the beginning of the short-circuit.
   Compare with the time evolutions shown in slide 14 (voltage) or 15 (current).

- Each group writes down and e-mail to me (t.vancutsem@ulg.ac.be) a report in PDF format no later than **March 20 at noon**.
- On March 24 (lecture # 7), you present your results using your PDF files.

- 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...