

ELEEC0431 Electromagnetic Energy Conversion

Solutions of additionnal exercises

Exercise 8 : Single-phase autotransformer

- 1) $m = 5$
- 2) $R_l = 50 \Omega$; $X_m = 6.3 \Omega$
- 3) $R_s = 0.24 \Omega$; $X_s = 0.32 \Omega$
- 4) $\Delta U_2 = 4.61 \text{ V}$; $U_2 = 95.4 \text{ V}$
- 5) $P_2 = 916 \text{ W}$
- 6) $I_1 = 62.3 \text{ A}$
- 7) $\eta = 95.6 \%$
- 8) $U'_1 = 80 \text{ V}$
- 9) $I'_{1o} = 0.8 \text{ A}$
- 10) $R'_s = 15 \text{ m}\Omega$; $X'_s = 20 \text{ m}\Omega$
- 11) $RC = 2.39 \text{ ms}$
- 12) $R_m = 5.41 \Omega$; $\eta_m = 99.2 \%$

Exercise 11 : Alternator and synchronous condenser

- 1) $\phi = 27^\circ$; $I = 4.16 \text{ kA}$
- 2) $Q = -66 \text{ kvar}$
- 3) Graph

Exercise 14 : Wind turbine

- 1) $\Gamma_i = \frac{U_s^2}{R_r + R} \frac{\dot{\theta}_s - \dot{\theta}}{\dot{\theta}_s^2}$
- 2) $\dot{\theta} = 159 \text{ rad/s}$ at 2 MW with $R = 0$ and $g = -1.25 \%$;
 $\dot{\theta} = 172 \text{ rad/s}$ et 4 MW with $R = 9 \text{ m}\Omega$; $g = -9.23 \%$

Exercise 17 : DC generator-motor mechanical coupling

- 1) $emf = 519.075 \text{ V}$
- 2) $p = 17.11 \text{ W}$
- 3) $P = 9603 \text{ W}$
- 4) $C = 88.17 \text{ Nm}$
- 5) $E_m = 502 \text{ V}$; $\dot{\theta} = 1076 \text{ rpm}$
- 6) $I = 360 \text{ A}$
- 7) $C = 1604 \text{ Nm}$
- 8) Ratio = 14.2 %