Chapitre IV – Transformateurs triphasés

Exercice 1 :

1/ le rapport de transformation

$$m = \frac{U_{20}}{U_1} = 0.02$$

2/

$$m = \frac{U_{20}}{U_1} = 0.02$$

$$U_1 = 4.44 n_1 f B_{max} S$$

$$V_2 = 4.44 n_2 f B_{max} S \Rightarrow U_{20} = \sqrt{3} 4.44 n_2 f B_{max} S$$

$$m = \frac{U_{20}}{U_1} = \frac{\sqrt{3} n_2}{n_1}$$

$$n_2 = 38 spires$$

3/

$$P_{1cc} = 3 r t_2 I^2_{2cc} \Rightarrow r t_2 = 12,8 \times 10^{-3} \Omega$$

4/

$$S_{2n} = \sqrt{3} U_{2n} I_{2n} \Rightarrow I_{2n} = 380 A$$

5/

a/

$$U_2 = U_{20} - (r t_2 \cos \varphi_2 - x t_2 \sin \varphi_2) I_2 \Rightarrow U_2 = 395.8 V$$

b/

$$\eta = \frac{\sqrt{3} U_2 I_2 \cos \varphi_2}{\sqrt{3} U_2 I_2 \cos \varphi_2 + P_{fer} + 3 r t_2 I_2^2} = 97.5\%$$

Exercice 2 :

1/

$$m = \frac{U_{20}}{U_1} = 72.7 \times 10^{-3}$$

2/

$$V_1 = 4.44 n_1 f B_{max} S$$
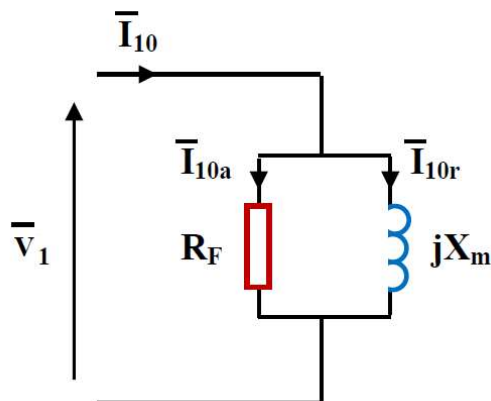$$\Rightarrow U_1 = \sqrt{3} \, 4.44 n_1 f B_{max} S$$
$$n_1 = \frac{U_1}{\sqrt{3} \, 4.44 f B_{max} S} = 426 \, spires$$

$$V_{20} = 4.44 n_2 f B_{max} S$$
$$\Rightarrow U_{20} = \sqrt{3} \, 4.44 n_2 f B_{max} S$$
$$n_{20} = \frac{U_{20}}{\sqrt{3} \, 4.44 f B_{max} S} = 31 \, spires$$

3/ schéma équivalent simplifié par phase à vide :

$$P_{10} = \frac{3V_1^2}{R_F} = \frac{U_1^2}{R_F} \Rightarrow R_F = 40.3\ k\Omega$$

$$Q_{10} = \frac{3V_1^2}{X_m} = \frac{U_1^2}{X_m} \Rightarrow X_m = 3{,}15\ k\Omega$$

4/

$$P_{1CC} = 3rt_2 I_{2CC}^2 \Rightarrow rt_2 = 41{,}3 \times 10^{-3}\ \Omega$$

$$xt_2 = \sqrt{\frac{m^2 V_{1CC}^2}{I_{2CC}^2} - rt_2^2} = \sqrt{\frac{m^2 U_{1CC}^2}{3I_{2CC}^2} - rt_2^2} = 73{,}1 \times 10^{-3}\ \Omega$$

5/

$$S_{2n} = \sqrt{3}\, U_{2n} I_{2n} \Rightarrow I_{2n} = 151{,}9\, A$$

6/

a/

$$U_2 = U_{20} - \sqrt{3}\left(rt_2 \cos\varphi_2 + xt_2 \sin\varphi_2\right) I_2 \Rightarrow U_2 = 380\, V$$

b/

$$\eta = \frac{\sqrt{3}\, U_2 I_2 \cos\varphi_2}{\sqrt{3}\, U_2 I_2 \cos\varphi_2 + P_{fer} + 3rt_2 I_2^2} = 95{,}7\%$$