③ PROBA T-P.

500 KVA 6000/230V ($f = 50Hz$).

Cortocircuito (AT)

$U_{cc} = 300V$ 50Hz

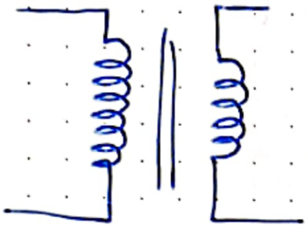
$I_{cc} = 83'33A = I_{n1}$

$P_{cc} = 8'2kW$

Baleiro

$U_{0} = 230V$ 50Hz.

$P_{B0} = 1'8kW$



a) I_n (6000 V)?

b) N_1, N_2, $B = 1200$ Gs?

c) d_1, d_2, $\delta_I = 4A/mm^2$

d) u_{cc}?

e) R_{cc}, Z_{cc}, X_{cc}?

f) u_{Rcc}, u_{Xcc}?

g) $\cos\varphi_{cc}$?

h) c ($\beta = 1/2$, $\cos\varphi = 0'2$ retraso)?

i) η ($\beta = 1/2$, indut. $\cos\varphi = 0'8$)

j) $S(\eta_{max})$.

k) η_{max} ($\cos\varphi = 0'8$)

l) $\Rightarrow R(\eta_{max})$? $\cos\varphi = 0'8$

a) $I_n = I_{cc} = 83'33A$

b) $U_1 = 4'44 \cdot N_1 f \Phi_{max} \Rightarrow N_1 = \dfrac{U_1}{4'44 \cdot f \cdot \Phi_{max}}$

$\Phi_{max} = B_{max} \cdot S_m$

$S_m = \sqrt{S} = \sqrt{500 \cdot 10^3} = 707'11 cm^2$

$B_{max} = 1200$ Gs $= \dfrac{12000 \text{ Gs}}{10000 \text{ Gs/T}} = 1'2T$

$\Phi_{max} = 1'2 \cdot 707'11 \cdot 10^{-4} = 85 mWb.$

$N_1 = \dfrac{6000}{4'44 \cdot 50 \cdot 85 \cdot 10^{-3}} = 318$ espiras

$N_2 = \dfrac{230}{4'44 \cdot 50 \cdot 85 \cdot 10^{-3}} = 13$ espiras

c) d_1, d_2 ($\delta_I = 4 A/mm^2$)?

$$d_1 = \frac{I}{S} \Rightarrow S_1 = \frac{I_1}{\delta_I} = \frac{83'33\,A}{4} = 20'83\ mm^2$$

$$S = \pi r^2 = \pi \left(\frac{d}{2}\right)^2 \Rightarrow d = \sqrt{\frac{4S}{\pi}}$$

$$d_1 = \sqrt{\frac{4 \cdot S_1}{\pi}} = \sqrt{\frac{4 \cdot 20'83}{\pi}} = \underline{5'15\ mm}$$

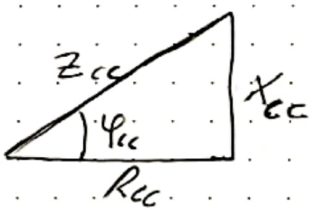
$$I_2 = S / U_2 = 2173'91\,A.$$

$$S_2 = \frac{I_2}{\delta_I} = \frac{2173'91}{4} = 543'48\ mm^2$$

$$d_2 = \sqrt{\frac{4 \cdot 543'48}{\pi}} = \underline{26'31\ mm^2}$$

d) $u_{cc} = \frac{U_{cc}}{U_n} \cdot 100 = \frac{300}{6000} \cdot 100 = \underline{5\%}$

e) $R_{cc} = P_{cc} / I_{cc}^2 = \frac{8'2 \cdot 10^3}{83'33^2} = \underline{1'18\,\Omega}$



$$Z_{cc} = U_{cc} / I_{cc} = 300 / 83'33 = \underline{3'6\,\Omega}$$

$$X_{cc} = \sqrt{Z_{cc}^2 - R_{cc}^2} = \underline{3'4\,\Omega}$$

f) $U_{Rcc} = I_{cc} R_{cc} = 98'33\,V$

$$\underline{u_{Rcc} = 1'64\,\%}$$

$$U_{Xcc} = I_{cc} X_{cc} = 299'99\,V$$

$$\underline{u_{Xcc} = 5\,\%}$$

$U_{n_1} = 6000\,V \rightarrow 100\,\%$

$U_{Rcc} = 98'33\,V \rightarrow u_{Rcc}\,\%$

$U_{n_2} = 6000\,V \rightarrow 100\,\%$

$U_{Xcc} = 299'99\,V \rightarrow u_{Xcc}\,\%$

g) $\cos\varphi_{cc} = \frac{R_{cc}}{Z_{cc}} = \underline{0'3278}$

h) $u = \beta (u_{Rcc} \cos\varphi + u_{Xcc} \sin\varphi) = \frac{1}{2}(1'64 \cdot 0'8 + 5 \cdot 0'6)$

$u = 2'16\,\%$

$\cos\varphi = 0'8$

$\sin\varphi = 0'6$

i) η ($\beta = 1/2$, $\cos\varphi = 0'8$ inductiva)

$$S_{1/2} = \frac{1}{2} S = 250\ kVA$$

$$\frac{S^2}{S_{1/2}^2} = \frac{P_{cu}}{P_{cu\,1/2}} \Rightarrow P_{cu\,1/2} = P_{cu} \frac{S_{1/2}^2}{S^2} = \frac{250^2}{500^2} \cdot 8'2$$

$$\underline{\underline{P_{cu\,1/2} = 2'05\ kW}}$$

$$P_2 = S\cos\varphi = 250 \cdot 0'8 = 200\ kW$$

$$\eta = \frac{P_2}{P_2 + P_{Fe} + P_{cu}} \cdot 100 = \frac{200}{200 + 1'8 + 2'05} \cdot 100 = \underline{\underline{98'112}}$$

(P_{Fe} constantes)

d) η_{max} ($\cos\varphi = 0'8$)?

$\eta_{max} \Rightarrow P_{cu}' = P_{Fe}$.

$$\frac{S^2}{S'^2} = \frac{P_{cu}}{P_{cu}'} \Rightarrow S' = \sqrt{S^2 \frac{P_{cu}'}{P_{cu}}} = S\sqrt{\frac{P_{cu}'}{P_{cu}}}$$

$$S' = 500\sqrt{\frac{1'8}{8'2}} = 234'26\ kVA$$

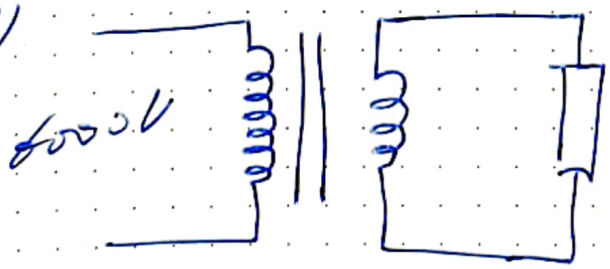
e) η_{max} ($\cos\varphi = 0'8$ inductiva).

$$\eta_{max} = \frac{P_2'}{P_2' + 2P_{Fe}} \cdot 100 = \frac{187'41}{187'41 + 2 \cdot 1'8} \cdot 100$$

$$P_2' = S'\cos\varphi = 187'41\ kW$$

$$\eta_{max} = 98'12\%$$

f)



Carga ohmica pura $\Rightarrow R \Rightarrow \cos\varphi = 1$

$$P_2 = U_R^2/R = U_2^2/R$$

$$R = U_2^2/P_2 = 230^2/187'41 \cdot 10^3$$

$$\underline{\underline{R = 0'28\ \Omega}}$$