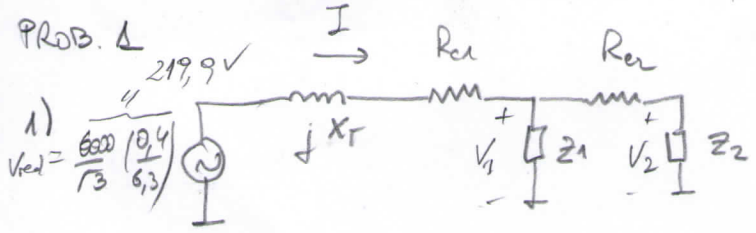
EXAMEN 12-2014.

PROB. 1



1) $V_{red} = \frac{6000}{\sqrt{3}} \left(\frac{0,4}{6,3}\right)$

$$X_T = \frac{0,05 \cdot 0,4\,kV^2}{0,3\,MVA} = 0,027.$$

$$R_{c1} = 350\,m\Omega/km \cdot 0,1\,km = 35\,m\Omega$$

$$R_{c2} = R_{c1}$$

$$Z_1 = \frac{380^2\,V}{(100\,kW/0,7)} \angle \arccos(0,7) = 0,708 + j\,0,722$$

$$Z_2 = \frac{380\,V^2}{\sqrt{130\,kW^2 + 100\,kVar^2}} \angle \operatorname{arctg}\left(\frac{100}{130}\right) = 0,698 + j\,0,537$$

2)

$$V_2 = \frac{V_1}{R_{c2} + Z_2} \cdot Z_2 = 195,18 + j\,5,54 \Rightarrow U_2 = \sqrt{3}\,|\vec{V}_2| = 338,2$$

$$V_1 = \frac{219,9}{jX_T + R_{c1} + Z_{eq}} \cdot Z_{eq} = 201,48 + 0,987\,j \Rightarrow U_1 = \sqrt{3}\,|\vec{V}_1| = 348,9\,V$$

$$Z_{eq} = Z_1 \,//\, (R_{c2} + Z_2) = 0,364 + 0,313\,j$$

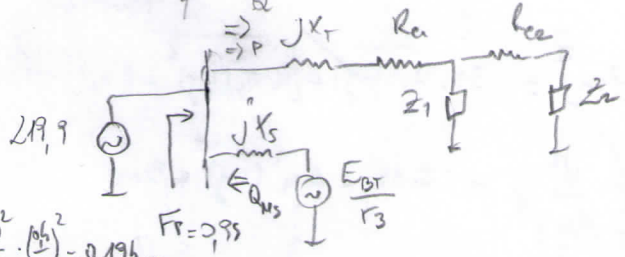
3)

$$\%\,T = \frac{|I|}{I_{nT}} = \frac{419,1}{433} = 96,9\,\%$$

$$I_{nT} = \frac{300\,kVA}{\sqrt{3}\,0,4\,kV} = 433\,A$$

$$\vec{I} = \frac{V_1}{Z_{eq}} = 319,8 - 271,8\,j \Rightarrow |I| = 419,7\,A$$

4)

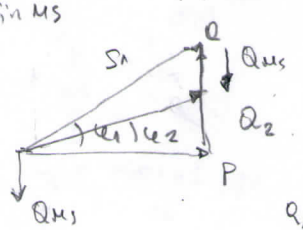


$$R_s = \frac{0,2 \cdot 6\,kW^2}{150\,kVA} \cdot \left(\frac{0,4}{6,3}\right)^2 = 0,196\,\Omega$$

$$S = 3\,\langle \vec{V}_{red}\,\vec{I}^{\,*} \rangle = \underset{P}{210,95\,kW} + j\,\underset{Q}{179,32\,kVar}$$

$$FP_1 = \frac{P}{\sqrt{P^2 + Q^2}} = 0,65 < 0,95$$

sin MS

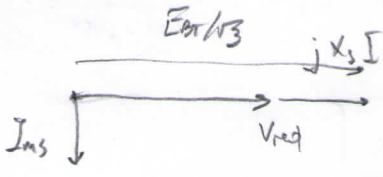


$$FP_2 = \frac{P}{\sqrt{P^2 + Q_2^2}} = 0,95$$

$$Q_2 = \sqrt{\left(\frac{P}{0,95}\right)^2 - P^2} = 69,34\,kVar$$

$$Q_{MS} = 179,32 - 69,34 = 109,98 \approx 110\,kVar$$

Diagrama MS

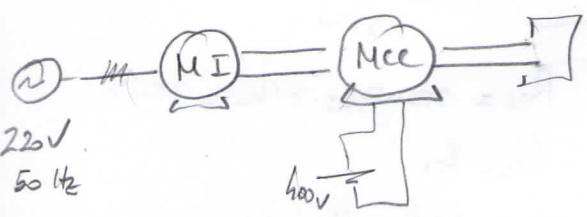


$$\frac{E_{BT}}{\sqrt{3}} = V_{red} + I_{MS} X_S = \underset{219,9}{252,2} \angle \underset{166,7 \cdot 0,196}{} = \frac{6000}{\sqrt{3}} \angle \left(\frac{0,4}{6,3}\right)$$

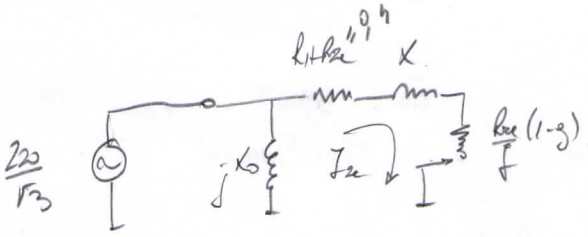
$$I_{MS} = \frac{Q_{MS}}{3\,V_{red}} = \frac{110\,kVar}{3 \cdot 219,9} = 166,7\,A$$

$$t = \frac{252,2\sqrt{3}}{6000} \cdot \frac{6,3}{0,4} = 1,15\,A$$

PROB. 2



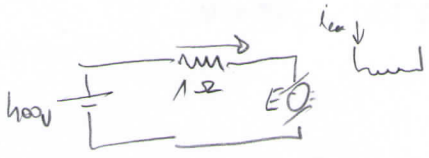
1 -



MI no consume activa ni entrega a la red $I_{2e}=0$. $C_{MI}=0$

Velocidad del sistema $n_s = 1500$ rpm

Mcc entrega las pérdidas de MI $P_{Mcc} = An^2 + Bn = 5\times10^{-5}\cdot(1500)^2 + 5\times10^{-3}\,1500 =$

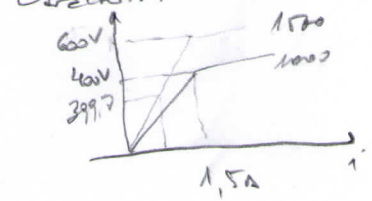


$E\,I = P_{Mcc} = 120\,W$

$E\left(\frac{400-E}{1\Omega}\right) = 120\,W$ → 0,300 = E

→ 399,7 = E

Característica Mcc:



$\frac{E}{n_1} = \frac{E}{n_2} = k_i$

$\frac{E}{e_{1500}} = \frac{400}{1000}\cdot 1500 = 600\,V$

$\frac{E}{i_{cc}} = \frac{600}{1,5} \Rightarrow i_{2e} = \frac{399,7\cdot 1,5}{600} = 0,999 \approx 1\,A$

2 -

Balance potencia

$P_{MI} + P_{Mcc} = P_{carga} + P_{pérd}$

$P_{MI} = P_{Mcc} \Rightarrow 2\left[3\frac{R_{2e}}{g}(1-g)I_{2e}^2\right] = \underbrace{50\cdot\omega_s(1-g)}_{C\cdot\omega} + \underbrace{\left[An_s^2(1-g)^2 + Bn_s(1-g)\right]}_{P_{pérd\,Mcc}}$

MPD

$I_{2e}^2 \simeq \frac{U^2}{3\left(\frac{R_{2e}}{g}\right)^2}$

$\frac{2\,R_{2e}}{g}\frac{U^2}{\left(\frac{R_{2e}}{g}\right)^2} = 50\,\omega_s + An_s^2(1-g)^2 + Bn_s$

$\omega_s = \frac{2\pi 1500}{60} = 50\pi$

$g\left(\frac{2U^2}{R_{2e}} + An_s^2\right) = 50\,\omega_s + Bn_s \Rightarrow g = 0,0325$

$P_{Mcc} = P_{MI} = \frac{0,4}{0,0325}(1-0,0325)\cdot\frac{220^2}{3\cdot 0,4}\,0,0325 = 3805\,W$ $\quad n = 1500(1-0,0325) = 1451$ rpm

$E\left(\frac{400-E}{1\Omega}\right) = 3805\,W \rightarrow E = 390,3\,V \Rightarrow i = \frac{390,3\cdot 1,5}{\frac{400}{1000}\cdot 1451} = 1,04\,A$

3 - $\eta = \frac{50\cdot\frac{2\pi 1451}{60}\,"\,P_{carga}}{P_{carga} + P_{pérd} + P_{Joule} + P_{Mcc}} = 92\,\%$

$P_{pérd} = 112,5\,W$

$P_{Joule} = 3(R_1+R_{2e})I_{2e}^2 = 374,2\,W$ (" 89,1) $\quad P_{Mcc} = 1\Omega\cdot\left(\frac{400-390,3}{1\Omega}\right)^2 + 80\Omega\,1\,A^2 = 174,1\,W$