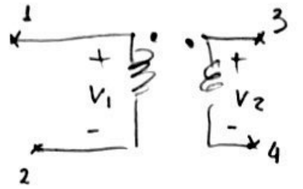
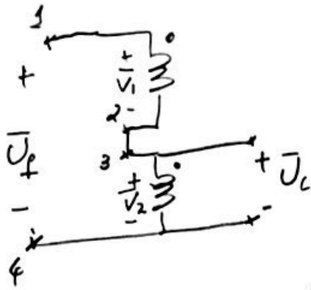
Autotransformadores

Dado un transformador T: U_{N1}/U_{N2} S_N



$\Rightarrow \frac{U_{N1}}{U_{N2}} = \frac{N_1}{N_2}$

Se conecta de la siguiente forma:

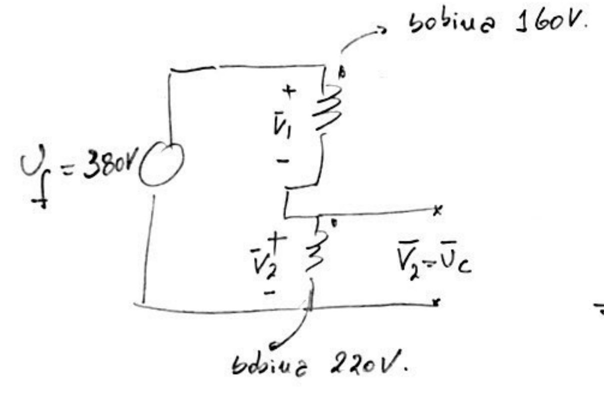


$\bar{U}_c = \bar{V}_2$

$\bar{U}_f = \bar{V}_1 + \bar{V}_2$ pero $\frac{\bar{V}_1}{N_1} = \frac{V_2}{N_2} \Rightarrow \bar{U}_f = \bar{V}_2\left(1 + \frac{N_1}{N_2}\right) = \bar{U}_c\left(\frac{N_1+N_2}{N_2}\right)$

$\Rightarrow \boxed{\bar{U}_c = \left(\frac{N_2}{N_1+N_2}\right) U_f}$ ó $\boxed{\bar{U}_c = \left(\frac{U_{N2}}{U_{N1}+U_{N2}}\right) U_f}$

Ejemplo T: 160/220 V 10 KVA.



$\bar{V}_1 + \bar{V}_2 = 380$

$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{160}{220}$

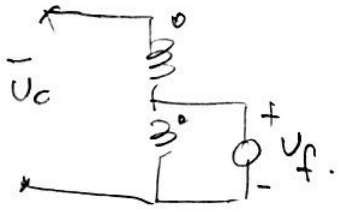
$\Rightarrow V_2\left(1 + \frac{160}{220}\right) = 380$

$\Rightarrow V_2 = \cancel{380} \times \frac{220}{\cancel{380}} = 220\,V.$

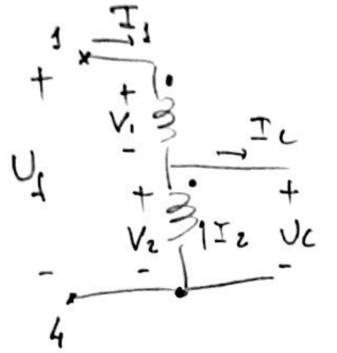
observar que se puede usar conectando fuente en V_2 y carga donde esta conectado U_f. ⇒
- → Autotrafo reductor
- → Autotrafo elevador

Reductor

Elevador



¿ Que potencia de Autotransformador se obtiene ?



$$N_1\bar{I}_1 = N_2\bar{I}_2$$

$$\bar{I}_1+\bar{I}_2 = \bar{I}_c \Rightarrow \bar{I}_c = \bar{I}_1\left(1+\frac{N_1}{N_2}\right)$$

Observar que el maximo valor que puede tomar I_1 sin sobrecargar el transformador es $I_{N1} = \frac{S_N}{U_{N1}}$

$$S_{NA} = \underbrace{\left(U_{1N}+U_{2N}\right)}_{\text{Maxima tension que se puede aplicar ente 1 y 4}} \overset{\text{Maxima corriente que}}{\bar{I}_{N1}} \text{ puede circular por la bobina primaria.}$$

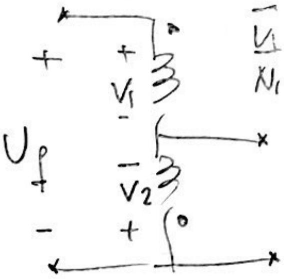
$$\Rightarrow S_{NA} = \left(U_{1N}+U_{2N}\right)\frac{S_N}{U_N} = \underline{\underline{\left(1+\frac{U_{2N}}{U_{1N}}\right)S_N > S_N.}}$$

En el ejemplo : $S_{AT} = \left(1+\frac{220}{160}\right)10\times10^3 = 23750\text{ VA} = 23{,}75\text{ KVA}.$

$\Rightarrow$ Con un transformador de 10KVA se puede suministrar 23,75 KVA !!

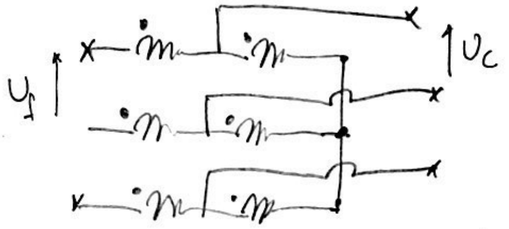
$\Rightarrow$ Mas economico que usar un transformador 380/220 23,75KVA !!

<u>Variantes:</u>



$$\frac{\bar{V}_1}{N_1} = \frac{\bar{V}_2}{N_2}$$

<u>caso Trifasico</u>



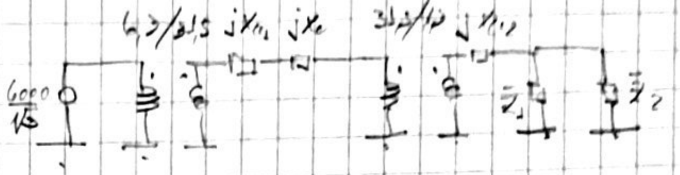
$$\bar{U}_f = \bar{V}_1-\bar{V}_2 = \bar{V}_2\left(1-\frac{N_1}{N_2}\right) \Rightarrow \bar{V}_2 = \left(\frac{U_{N2}}{U_{N2}-U_{N1}}\right)\bar{U}_f$$

En el ejemplo : $380 = V_2\left(1-\frac{160}{220}\right)$

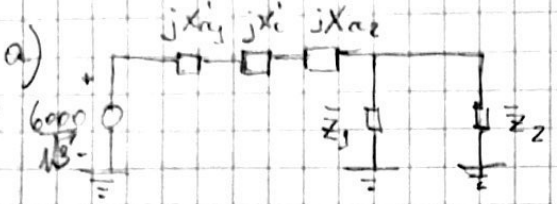
$$\Rightarrow \bar{V}_2 = 380\times\frac{220}{60}$$

Ex. 22/02/2013

Problema 1



a)



$$X_{cc_1} = 0,1 \times \frac{31,5^2}{10} = 9,922\ \Omega \Rightarrow X'_{cc_1} = X_{cc_1}\left(\frac{6,3}{31,5}\right)^2 = \underline{0,397\ \Omega}$$

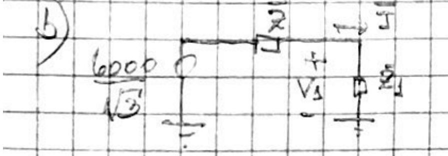
$$X_c = 0,004 \times 2000 = 8\ \Omega \Rightarrow X'_C = X_C\left(\frac{6,3}{31,5}\right)^2 = \underline{0,32\ \Omega}$$

$$X_{cc_2} = 0,1 \times \frac{6,3^2}{10} = \underline{0,397\ \Omega}$$

$$\bar Z_1 = \frac{6300/\sqrt3}{I} \angle \text{Arccos}\,0,7 \quad I = \frac{2\times10^6}{\sqrt3\times6300\times0,7} = 262,15 \Rightarrow \bar Z_1 = \underline{13,89} \angle 45,57 = 9,723 + j9,917$$

$$\bar Z_2 = \frac{6300/\sqrt3}{550,5} \cancel{\angle \text{Arccos}\left(\frac{6\times10^6}{\sqrt3\times6300\times550,5}\right)} = \underline{6,62}\ \Omega \angle 0°$$

b)



$$\bar Z = (2\times0,397 + 0,32)\,j = 1,12j\ \Omega$$

$$\bar I = \frac{6000/\sqrt3}{\bar Z + \bar Z_1} = \frac{6000/\sqrt3}{1,12j + 9,723 + j9,919} = \frac{6000/\sqrt3}{9,723 + j11,04} = \frac{6000/\sqrt3}{14,71\angle\varphi}$$

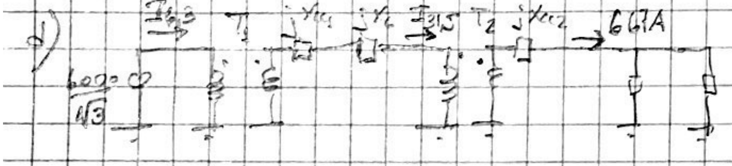
$$\Rightarrow |\bar I| \simeq 236\ A \Rightarrow V_1 = 13,89 \times 236 = 3278\ V \Rightarrow U_1 = \sqrt3\, V_1 = \underline{\underline{5671\ V}}$$

c)

$$\bar Z_1 // \bar Z_2 = 4,66 + j1,189\ \Omega \Rightarrow \bar I = \frac{6000/\sqrt3}{1,12j + 4,66 + j1,189} = \frac{6000/\sqrt3}{4,66 + j2,31} \Rightarrow |\bar I| = \frac{600/\sqrt3}{5,2}$$

$$\Rightarrow |\bar I| \simeq 667\ A \Rightarrow V_1 = 4,81 \times 667 = 3208,3\ V \Rightarrow U_1 = \underline{\underline{5550,4\ V}}$$

d)



$$I_{31,5} = 667 \times \frac{6,3}{31,5} = 133,4\ A$$

$$\Rightarrow I_{6,3} = 133,4 \times \frac{31,5}{6,3} = 667\ A$$

$$T_1 : I_n = \frac{10\times10^6}{\sqrt3\times6300} = 917,5\ A$$

T_2 : Misma corriente nominal

$\Rightarrow$ Estado de carga de T_1 y T_2: $\frac{667}{917,5} = 0,727 \Rightarrow \underline{72,7\%}$

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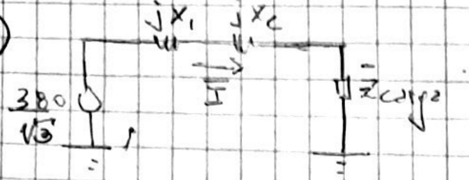
Problema 2.

Ex 12/02/2013

a)



$X_1 = 0{,}04 \times \frac{380^2}{200 \times 10^3} = 0{,}0289\ \Omega.$

$X_c = j\,0{,}1\ \Omega.$

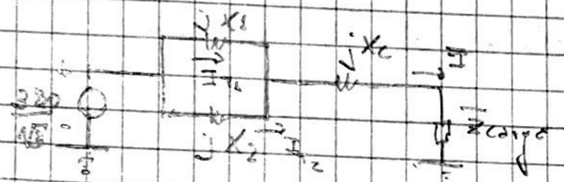
$Z_c = 0{,}4 + j\,0{,}4\ \Omega$

$\bar{I} = \frac{380/\sqrt{3}}{j0{,}0289 + j0{,}1 + 0{,}4 + j0{,}4} = \frac{220}{0{,}4 + j0{,}529} \Rightarrow |\bar{I}| \cong 332\ A$

$I_N = \frac{200 \times 10^3}{\sqrt{3} \times 380} = 304{,}23\ A \Rightarrow \frac{\bar{I}}{I_N} = 1{,}09 \Rightarrow$ 9% de sobrecarga!!

b)

c)

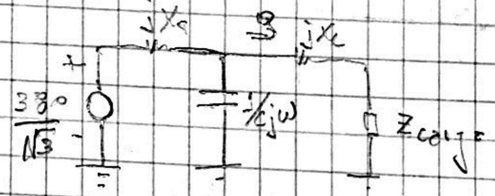


$X_1 = X_2 = 0{,}0289.$

d) $\bar{I} = \frac{220}{j\frac{X_1}{2} + jX_c + \bar{Z}_{carga}} \Rightarrow |\bar{I}| = 337{,}6\ A. \Rightarrow I_{T1} = \frac{337{,}6}{2} = I_{T2} = 168{,}8\ A$

$\Rightarrow \frac{I}{I_N} = \frac{168{,}8}{304{,}23} = 0{,}555 \Rightarrow$ 55,5% cada transformador.

e)



La carga consume una determinada potencia reactiv Q parte de la cual será entregada por el banco de capacitores por lo cual el transito de reactiva por los trafos. baja => baja la corriente