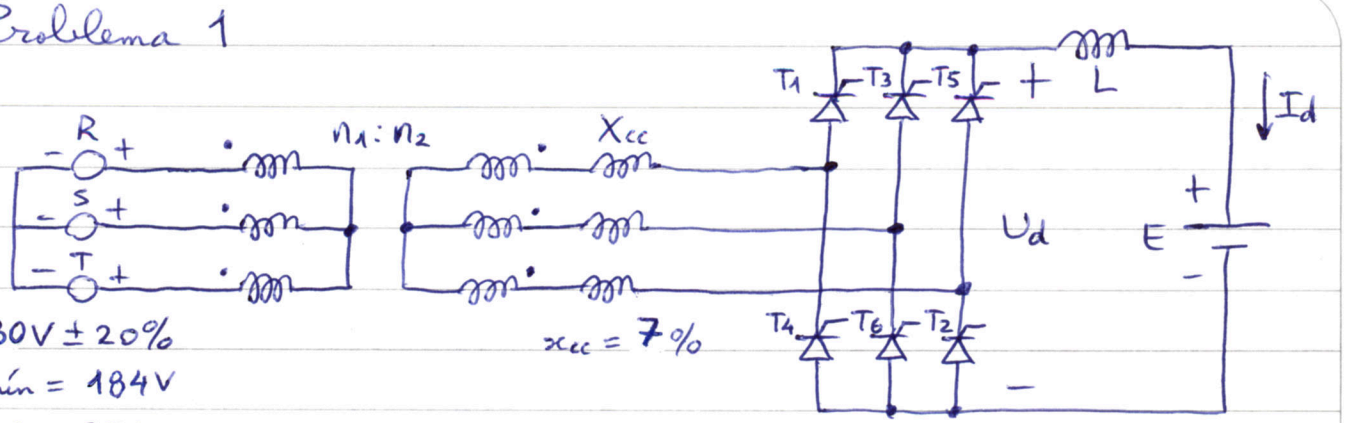
Examen de Electrónica de Potencia - 11/12/2018 - N.G.

Problema 1



$U = 230\,V \pm 20\%$

$\Rightarrow \begin{cases} U_{mín} = 184\,V \\ U_{máx} = 276\,V \end{cases}$

$x_{cc} = 7\%$

$\alpha_{mín} = 15°$ $\quad I_{d\,máx} = 20\,A$

$\begin{cases} U_{d\,mín} = 0\,V \\ U_{d\,máx} = 110\,V \end{cases}$

(1) $U_d = \frac{3}{\pi}\sqrt{2}\left(U\frac{n_2}{n_1}\right)\cos(\alpha) - \frac{3}{\pi}X_{cc}I_d$

Corriente nominal del transformador:

$I_n = \sqrt{\frac{2}{3}}\,I_{d\,máx} = \sqrt{\frac{2}{3}}\,(20\,A) = 16{,}33\,A$

$X_{cc} = x_{cc}\frac{U_n}{\sqrt{3}I_n} = x_{cc}\left(\frac{n_2}{n_1}\right)\frac{U}{\sqrt{3}I_n}$

Caso más restrictivo: cuando se quiere entregar $U_d = 110\,V$ con $U = U_{mín} = 184\,V$ e $I_d = I_{d\,máx} = 20\,A$, $\alpha = \alpha_{mín}$.

$\frac{3}{\pi}\sqrt{2}\left(U_{mín}\frac{n_2}{n_1}\right)\cos(\alpha_{mín}) - \frac{3}{\pi}x_{cc}\left(\frac{n_2}{n_1}\right)\frac{U}{\sqrt{3}\left(\sqrt{\frac{2}{3}}I_{d\,máx}\right)} \geq U_{d\,máx}$

$\frac{n_2}{n_1}\left(\frac{3}{\pi}\sqrt{2}U_{mín}\cos(\alpha_{mín}) - \frac{3}{\pi}x_{cc}\frac{U}{\sqrt{2}}\right) \geq U_{d\,máx}$

$\frac{n_2}{n_1} \geq \frac{(110\,V)}{\frac{3}{\pi}\sqrt{2}(184\,V)\cos(15°) - \frac{3}{\pi}(7\%)\frac{(230\,V)}{\sqrt{2}}} = \boxed{0{,}48}$

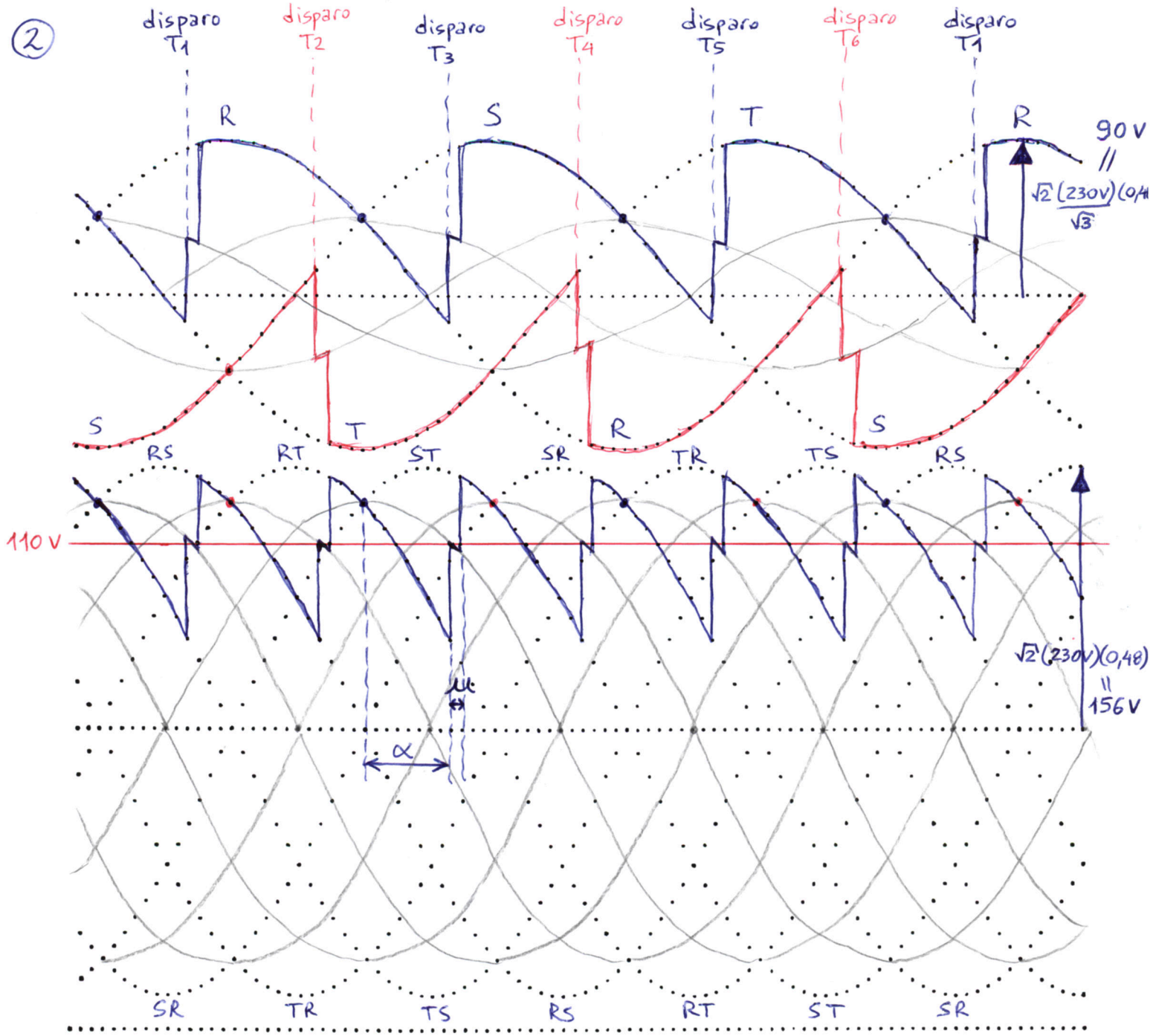
(2) Para $U = 230\,V$, $I_d = 20\,A$ y $U_d = 110\,V$:

$\frac{3}{\pi}\sqrt{2}\left(U\frac{n_2}{n_1}\right)\cos(\alpha) - \frac{3}{\pi}X_{cc}I_d = U_d$

$\alpha = \arccos\left(\frac{U_d + \frac{3}{\pi}X_{cc}I_d}{\frac{3}{\pi}\sqrt{2}U\left(\frac{n_2}{n_1}\right)}\right) = \boxed{39{,}4°}$

$\mu = \arccos\left(\cos(\alpha) - \frac{2X_{cc}I_d}{\sqrt{2}U\left(\frac{n_2}{n_1}\right)}\right) - \alpha = \boxed{6{,}0°}$

(2)


disparo T1
disparo T2
disparo T3
disparo T4
disparo T5
disparo T6
disparo T1
R
S
T
R
90 V
//
√2 (230V) (0,4
√3
S
T
R
S
RS
RT
ST
SR
TR
TS
RS
110 V
√2 (230V) (0,48)
//
156 V
α
SR
TR
TS
RS
RT
ST
SR

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③ Corriente límite de conducción continua - discontinua:

$$I_{lím} = \frac{1}{8} \cdot \frac{U\left(\frac{n_2}{n_1}\right)}{L\omega} \sin(\alpha) < 10\,A$$

↳ para cualquier condición de operación

Despreciando el efecto de la conmutación:

$$U_d = \frac{3}{\pi}\sqrt{2}\left(U\,\frac{n_2}{n_1}\right)\cos(\alpha)$$

$$\Rightarrow \alpha = \arccos\left(\frac{U_d}{\frac{3}{\pi}\sqrt{2}\,U\left(\frac{n_2}{n_1}\right)}\right)$$

$$L > \frac{1}{8} \cdot \frac{U\left(\frac{n_2}{n_1}\right)}{(10\,A)\,\omega} \sin(\alpha)$$

El caso más restrictivo se da para $\sin(\alpha) = 1$, es decir $\alpha = 90° \Rightarrow U_d = 0\,V$,

y para $U = U_{máx} = 276\,V$.

$$\Rightarrow L > \frac{1}{8} \cdot \frac{(276\,V)(0{,}48)}{(10\,A)(2\pi)(50\,Hz)} \sin(90°) = \boxed{5{,}27\,mH}$$