Corrigé TD N°3

Exercice1

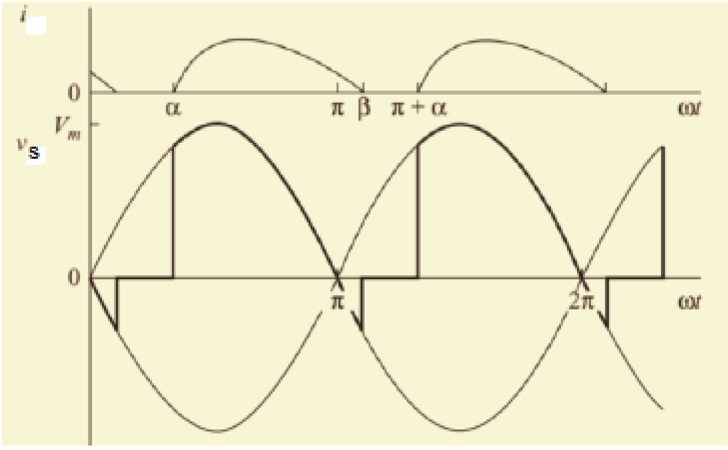
Le transformateur à point milieu possède un enroulement primaire et deux enroulements secondaires identiques possédant une borne commune. Les deux enroulements secondaires délivrent chacun une tension de même valeur efficace mais en opposition de phases.

Le courant de charge d'un redresseur controlé à double alternance avec une charge RL peut etre continu ou discontinu

Cas discontinu :

le courant de charge atteint zéro à $\omega t = \beta \quad et \;\; \beta < \pi + \alpha$

$$i_s(\omega t) = \frac{U_m}{Z}\left(\sin(\varphi - \alpha) e^{-\frac{(\omega t - \alpha)}{\tan\varphi}} + \sin(\omega t - \varphi) \right)$$



Cas continu :

le courant de charge est supérieor à zéro à

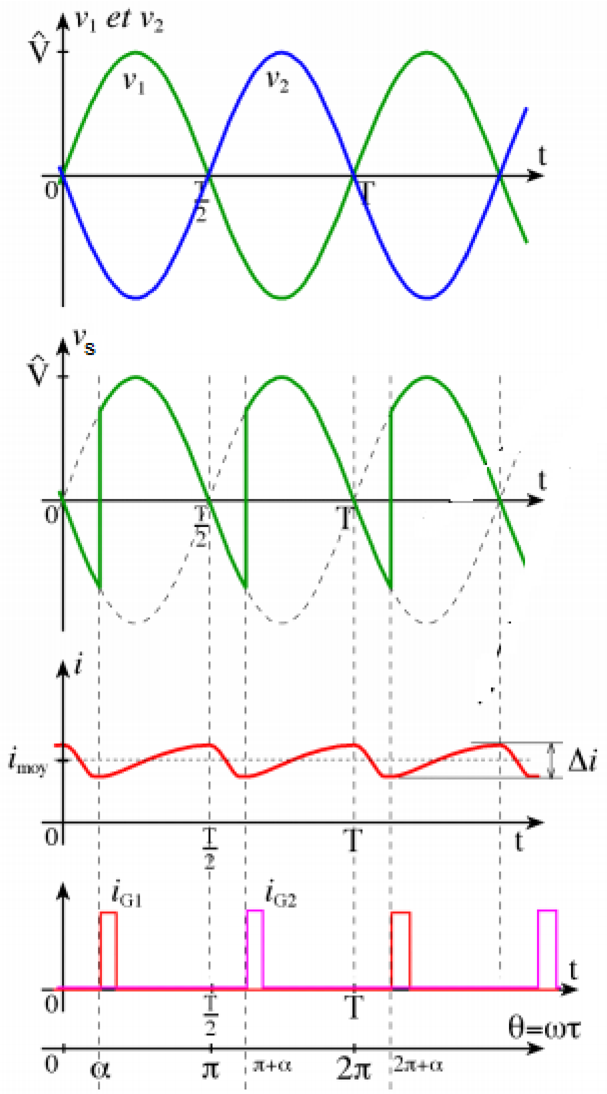
$$i > 0 \, à \, \omega t = \pi + \alpha \Rightarrow i(\pi + \alpha) > 0$$

$$i_s(\pi + \alpha) = \frac{U_m}{Z}\left(\sin(\varphi - \alpha) e^{-\frac{(\pi+\alpha-\alpha)}{\tan\varphi}} + \sin(\pi + \alpha - \varphi) \right) > 0$$

$$\sin(\varphi - \alpha) e^{-\frac{(\pi)}{\tan\varphi}} + \sin(\varphi - \alpha) > 0 \Rightarrow \sin(\varphi - \alpha)\left(e^{-\frac{(\pi)}{\tan\varphi}} + 1 \right) > 0$$

$$\Rightarrow \sin(\varphi - \alpha) > 0 \Rightarrow 0 < \varphi - \alpha < \pi \Rightarrow \varphi - \alpha > 0 \Rightarrow \alpha < \varphi$$

$$\Rightarrow \alpha < \tan^{-1}\left(\frac{L\omega}{R}\right) \Rightarrow \alpha < \tan^{-1}\left(\frac{0.1\times 120\pi}{15}\right) \Rightarrow \alpha < 144°$$



$$V_{smoy} = \frac{1}{\pi}\int_{\alpha}^{\pi+\alpha} V_{max} \sin\theta d\theta = -\frac{V_{max}}{\pi}\left(\cos(\pi + \alpha) - \cos\alpha\right)$$

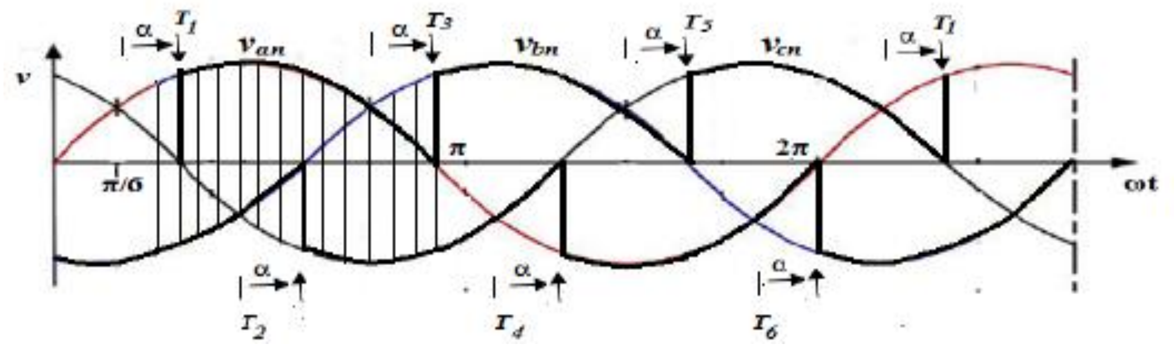
$$= \frac{2V_{max}}{\pi}\cos\alpha = 108V$$

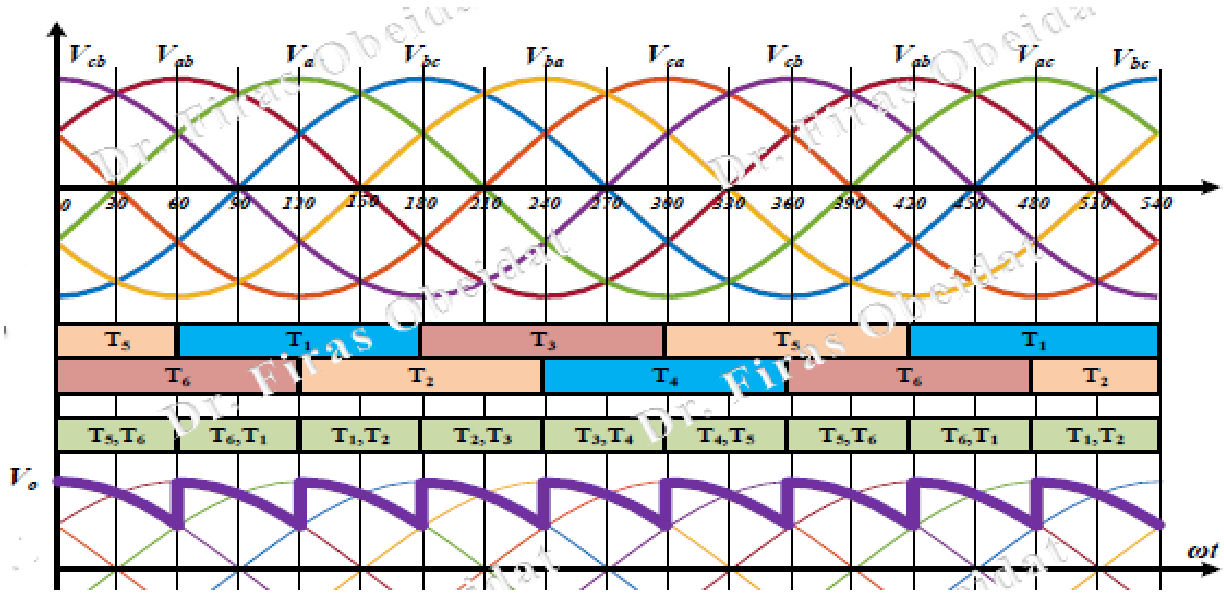
$$i_{moy} = \frac{2V_{max}}{\pi R}\cos\alpha = 7.2A$$

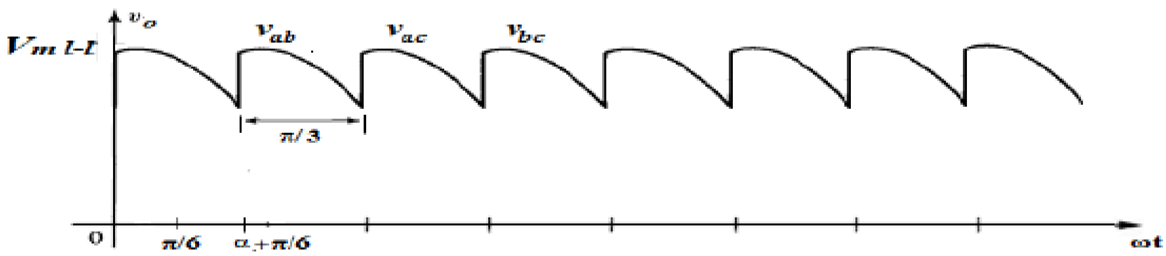
$$V_{seff}^2 = \frac{1}{\pi}\int_{\alpha}^{\pi+\alpha} \left(V_{max}\sin\theta\right)^2 d\theta \Rightarrow V_{seff} = \frac{V_{max}}{\sqrt{2}} = \frac{339}{\sqrt{2}} = 240V$$

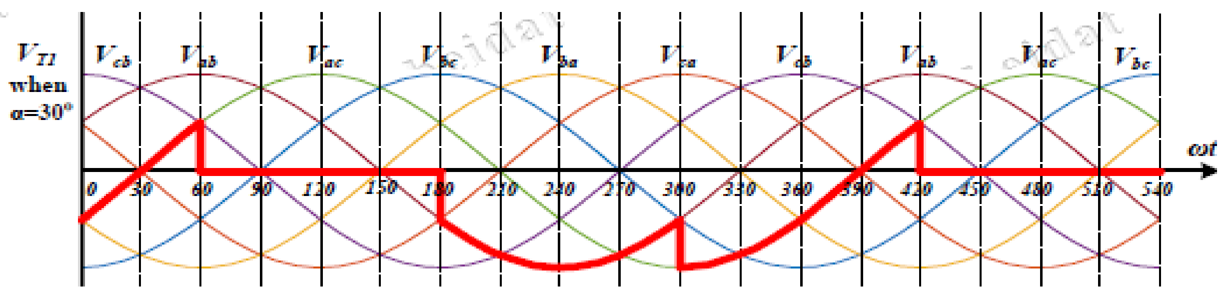
$$I_{eff} = \frac{V_{seff}}{Z} = \frac{V_{max}}{\sqrt{2}\sqrt{R^2 + (L\omega)^2}} = \frac{240}{\sqrt{15^2 + (0.1\times 120\pi)^2}} = 6A$$

Exercice 2


v
α
T_1
v_{an}
T_3
v_{bn}
T_5
v_{cn}
π/6
π
2π
ωt
T_2
T_4
T_6


V_{cb} V_{ab} V_{ac} V_{bc} V_{ba} V_{ca} V_{cb} V_{ab} V_{ac} V_{bc}
0 30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480 510 540
T_5 T_1 T_3 T_5 T_1
T_6 T_2 T_4 T_6 T_2
T_5,T_6 T_6,T_1 T_1,T_2 T_2,T_3 T_3,T_4 T_4,T_5 T_5,T_6 T_6,T_1 T_1,T_2
V_o
ωt


v_o
$V_{m\,L-L}$
v_{ab} v_{ac} v_{bc}
π/3
0
π/6
α+π/6
ωt


V_{T1} when α=30°
V_{cb} V_{ab} V_{ac} V_{bc} V_{ba} V_{ca} V_{cb} V_{ab} V_{ac} V_{bc}
ωt
0 30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480 510 540

Intervalles	$\left[\frac{\pi}{6}+\alpha,\frac{\pi}{2}+\alpha\right]$	$\left[\frac{\pi}{2}+\alpha,\frac{5\pi}{6}+\alpha\right]$	$\left[\frac{5\pi}{6}+\alpha,\frac{7\pi}{6}+\alpha\right]$	$\left[\frac{7\pi}{6},\frac{9\pi}{6}+\alpha\right]$	$\left[\frac{9\pi}{6}+\alpha,\frac{11\pi}{6}+\alpha\right]$	$\left[\frac{11\pi}{6}+\alpha,\frac{13\pi}{6}+\alpha\right]$
Thyristors	**T1 T6**	**T1 T2**	**T3 T2**	**T3 T4**	**T5 T4**	**T5 T6**
Tension v_s	U_{ab}	U_{ac}	U_{bc}	U_{ba}	U_{ca}	U_{cb}
Tension v_{T1}	**0**	**0**	U_{ab}	U_{ab}	U_{ac}	U_{ac}

$$\langle v_o\rangle=\frac{1}{T}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}U_{ab}d\theta=\frac{1}{\frac{\pi}{3}}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}\sqrt{3}V_{\max}\sin\left(\omega t+\frac{\pi}{6}\right)d\theta$$

$$=\frac{3\sqrt{3}V_{\max}}{\pi}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}\left(\sin\omega t\cos\frac{\pi}{6}+\sin\frac{\pi}{6}\cos\omega t\right)d\theta=\frac{3\sqrt{3}V_{\max}}{\pi}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}\left(\frac{\sqrt{3}}{2}\sin\omega t+\frac{1}{2}\cos\omega t\right)d\theta$$

$$=\frac{3\sqrt{3}V_{\max}}{\pi}\cos\alpha$$

$$V_{oeff}=\frac{1}{T}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}U_{ab}^{2}d\theta=\frac{1}{\frac{\pi}{3}}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}\left[\sqrt{3}V_{\max}\sin\left(\omega t+\frac{\pi}{6}\right)\right]^2d\theta=3V_{\max}\int_{\frac{\pi}{6}+\alpha}^{\frac{\pi}{2}+\alpha}\frac{1}{2}+\frac{3\sqrt{3}}{4\pi}\cos 2\alpha$$