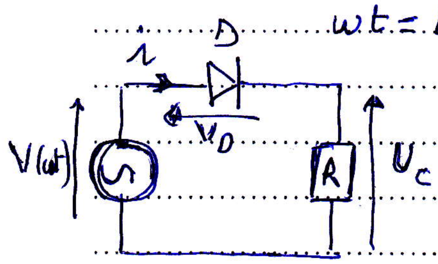
Dept ELT 3$^{ème}$ ELM
Module : ELP

# TD N° 1

## EXO1

$V(wt) = V_m \sin(wt)$

$wt = \theta \quad , \quad T = 2\pi$




Loi des mailles :

$V(\theta) - V_D - U_c = 0$

$V_D = V(\theta) - U_c$ ---- (1)

à $t = 0 \rightarrow i = 0$

$\Rightarrow U_c = Ri = 0$

$\Rightarrow V_D = V(\theta)$

$\Rightarrow$ Si $V(\theta) > 0 \Rightarrow$ D passante

si $V(\theta) < 0 \Rightarrow$ D bloquée

$t \in [0 \quad T/2]$

Alors $\theta \in [0 \quad \pi] \rightarrow V(\theta) > 0$

$\Rightarrow$ D passante $\Rightarrow V_D = 0$

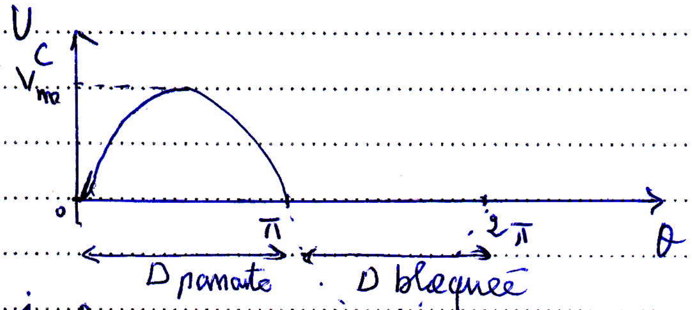
(1) $\Rightarrow U_c = V(\theta) \quad , \quad i(\theta) = \frac{V(\theta)}{R}$

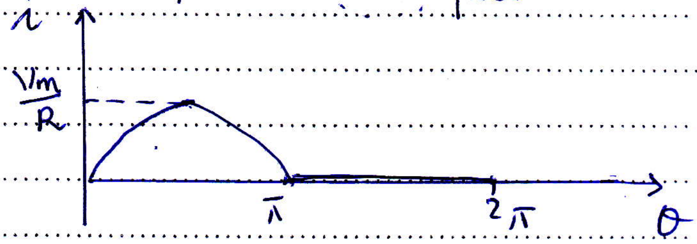
$t \in [\frac{T}{2} \quad T]$

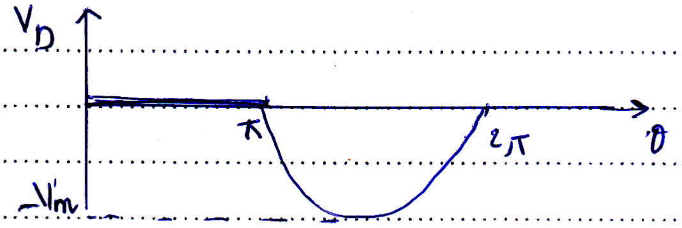
$\theta \in [\pi \quad 2\pi] \Rightarrow V(\theta) < 0$

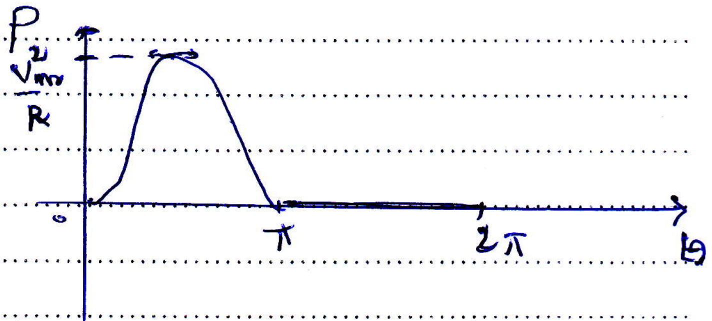
$\Rightarrow V_D < 0 \Rightarrow$ D bloquée

$$\begin{cases} U_c = 0 \rightarrow i(\theta) = 0 \\ V_D = V(\theta) \end{cases}$$




La puissance instantanée :

$P(t) = U_c(t) \, i(t)$

La valeur moyenne de la puissance instantanée = Puissance active

$$P = \frac{1}{2\pi} \int_0^{\pi} V_m \sin(\theta) \cdot \frac{V_m}{R} \sin(\theta) \, d\theta$$

$$= \frac{V_m^2}{2\pi R} \int_0^{\pi} \frac{1}{2}(1 - \cos 2\theta) \, d\theta$$

$$= \frac{V_m^2}{4\pi R} \left[ \theta - \frac{1}{2} \sin(2\theta) \right]_0^{\pi}$$

$$P = \frac{V_m^2}{4\pi R} \cdot \pi \Rightarrow P = \frac{V_m^2}{4R}$$

D idéale $\Rightarrow$ puissance consommée par la diode est nulle, alors :

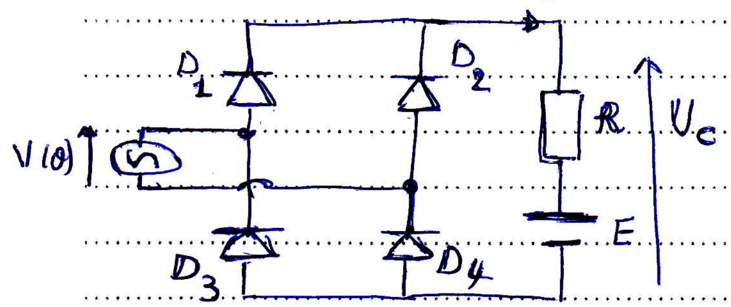
$$P = R i_{eff}^2 = \frac{V_m^2}{4R}$$

$$\Rightarrow i_{eff} = \frac{V_m}{2R}$$

EXO 2

$$V(\omega t) = V_m \sin(\omega t),$$

$V_m = \sqrt{2}\,220\,V$, $R = 10\Omega$, $E = 100\,V$




Les angles d'amorçage des diodes :

$\theta \in [0 \quad \pi]$ : $D_1, D_4$

on a : $V(\theta) - V_{D_1} - U_c - V_{D_4} = 0$

$$2V_{D_1} = V(\theta) - U_c$$

$$V_{D_1} = \frac{1}{2}(V(\theta) - U_c), \quad U_c = Ri + E$$

Si $i_c = 0 \Rightarrow U_c = E$.

$$V_D = \frac{1}{2}(V(\theta) - E)$$

~~V=~~ $D_{1,4}$ ~~est~~ passantes si $V(\theta) - E \geq 0$

$$\Rightarrow V(\theta) \geq E$$

$$\Rightarrow V_m \sin(\theta) \geq E \Rightarrow \sin\theta \geq \frac{E}{V_m}$$

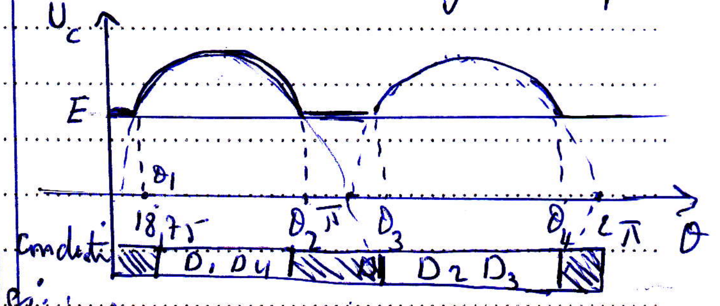
$$\Rightarrow \theta \geq \arcsin\left(\frac{E}{V_m}\right)$$

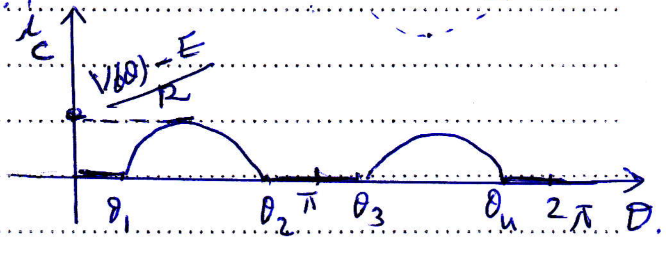
$$\begin{cases} \theta_1 = \arcsin\left(\frac{100}{\sqrt{2}\,220}\right) = 18{,}75^\circ \\ \theta_2 = 180^\circ - \theta_1 = 161{,}25^\circ \end{cases}$$

Donc pour que l'amorçage de $[0 \; \pi]$ sera possible il faut que :

$$18{,}75^\circ \leq \theta \leq 161{,}25^\circ$$

$\theta < 18{,}75$ l'amorçage est impossible.




Les séquences de fonctionnement

$\theta \in [0 \quad \theta_1] \rightarrow E > V(\theta)$

$D_{1,4}$ bloquée $\Rightarrow i_c = 0 \Rightarrow U_c = E$

$\theta \in [\theta_1 \quad \theta_2] \rightarrow V(\theta) \geq E$

$D_{1,4}$ passantes $\Rightarrow V_D = 0$.

$$U_c = V(\theta) \Rightarrow i_c = \frac{V(\theta) - E}{R}$$

$\theta \in [\theta_2 \quad \pi]$ , $V(\theta) < E$

$D_{1,4}$ bloquées $\Rightarrow U_c = E$

$i_c = 0$.

$\theta \in [\pi \quad 2\pi]$

* Les angle d'amorçage des diodes $D_2$, $D_3$ sont

$\theta_3 = \pi + \theta_1 = 180^\circ + 18{,}75$

$\theta_4 = 2\pi - \theta_1 = 360^\circ - 18{,}75$

loi des mailles

$-V(\theta) - V_{D_2} - U_c - V_{D_3} = 0$

$2V_{D_2} = -V(\theta) - U_c$

$V_{D_2} = \frac{1}{2}(-V(\theta) - U_c)$

si $i_c = 0$ $\quad U_c = E$

$D_2, D_3$ passantes

si $V_{D_2} \geqslant 0 \Rightarrow -V(\theta) - E \geqslant 0$

$V(\theta) + E \leqslant 0 \Rightarrow \cancel{V(\theta)}$

$E \leqslant -V(\theta)$

Alors: $\theta \in [\pi \quad \theta_3]$

$E \geqslant -V(\theta)$ $\quad D_2, D_3$ bloquées

$U_c = E, \quad i_c = 0$.

$\theta \in [\theta_3 \quad \theta_4] \rightarrow E \leqslant -V(\theta)$

$D_2, D_3$ passantes $\Rightarrow$

$U_c = V(\theta)$, $\quad i_c = \frac{V(\theta) - E}{R}$

$\theta \in [\theta_4 \quad 2\pi] \Rightarrow E \geqslant -V(\theta)$

$D_2, D_3$ bloquées.

$U_c = E, \quad i_c = 0$.

- Calcul de $U_{c\,moy}$

$$U_{c\,moy} = \frac{1}{T}\int^{T} U_c(\theta)\, d\theta.$$

$$\underline{U_{c\,moy}} = \frac{1}{\pi}\left[\int_0^{\theta_1} E\, d\theta + \int_{\theta_1}^{\theta_2} V_m \sin(\theta)\, d\theta + \int_{\theta_2}^{\pi} E\, d\theta\right]$$

$$= \frac{1}{\pi}\left[ [E\,\theta]_0^{\theta_1} + V_m(-\cos\theta)_{\theta_1}^{\theta_2} + [E\,\theta]_{\theta_2}^{\pi}\right]$$

$$= \frac{1}{\pi}\left[E\theta_1 + V_m(-\cos\theta_2 + \cos\theta_1) + E\pi - E\theta_2\right]$$

$$= \frac{1}{\pi}\left[E\theta_1 + 2V_m \cdot 0{,}947 + E\pi - E\theta_2\right]$$

$$= \frac{1}{\pi}\left(2E\theta_1 + 1{,}89\, V_m\right) \longrightarrow$$