- Système linéaires du Premier Ordre.

- $\tau \frac{ds(t)}{dt} + s(t) = e(t) \Rightarrow \tau p\, S(p) + S(p) = E(p)$

$\Rightarrow \boxed{T(p) = \frac{S(p)}{E(p)} = \frac{1}{1+\tau p}} \quad \boxed{s(t) = \frac{1}{\tau} e^{-t/\tau}}$

T_R : Temps de réponse. $\rightarrow$ 1er ordre

τ : Constante de temps.

- Système linéaires du deuxième ordre.

$T^2 \frac{d^2 s(t)}{dt^2} + 2\eta T \frac{ds(t)}{dt} + s(t) = K_s\, e(t)$

K_s : gain statique

$T^2 p^2 S(p) + 2\eta T p\, S(p) + S(p) = K_s E(p)$

$T(p) = \frac{S(p)}{E(p)} = \frac{K_s}{T^2 p^2 + 2\eta T p + 1}$ / $\eta > 0$ et $T > 0$

On pose $T = 1/\omega_n$

Où : $T(p) = \frac{K_s}{\frac{1}{\omega_n^2} p^2 + \frac{2\eta\omega_n}{\omega_n^2} p + 1} = \frac{K_s \omega_n^2}{p^2 + 2\eta\omega_n p + \omega_n^2}$

ω_n : fréquence naturelle du système non amorti

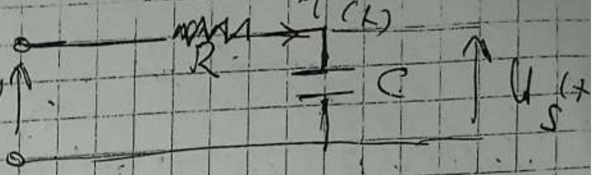
η : le rapport d'amor

$\alpha = \eta / T = \eta \omega_n$: le coefficient d'amorti

$1/\alpha = 1/\eta\omega_n$: la constante de temps

T_s : est le temps de stabilisation

$\omega_R = \omega_n \sqrt{1 - 2\eta^2}$



$$V_s(t) = \frac{1}{C}\int i(t)\,dt \quad V_s$$

$$V_e(t) = R\,i(t) + \frac{1}{C}\int i(t)\,dt$$

$$i(t) = C\,\frac{dV_s(t)}{dt}$$

$$V_e(t) = R\,C\,\frac{dV_s(t)}{dt} + V_s(t)$$

$$T(p) = \frac{S(p)}{E(p)}$$

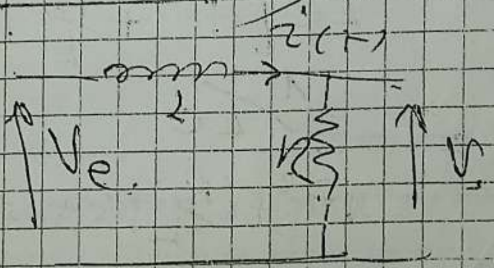
$$V_e(p) = R\,C\,p\,V_s(p) + V_s(p)$$

$$V_e(p) = V_s(p)\left[1 + R\,C\,p\right]$$

$$T(p) = \frac{V_s(p)}{V_e(p)} = \frac{1}{(1 + RCp)} \qquad \frac{1}{1+\tau p} =$$

$$T(p) = \frac{1}{1+\tau p} \Rightarrow T(p) \longrightarrow 1^{er}\ \text{ordre}$$

$$\Rightarrow \boxed{\tau = RC}$$



$$V_e(t) = \underbrace{R\,i(t)}_{V_s(t)} + \underbrace{L\,\frac{di(t)}{dt}}_{V_s(t)}$$

$$V_e(t) = R\,I(p) + L\,p\,I(p)$$

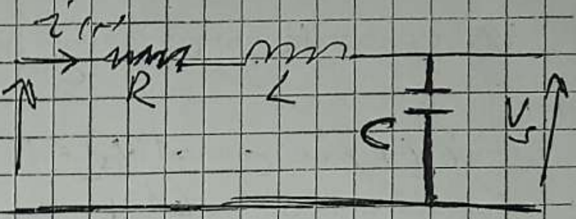
$$V_e(t) = I(p)\,(R + L\,p)$$

$$= \underbrace{R\,I(p)}_{V_s}\left(1 + \frac{L}{R}\,p\right)$$

$$\Rightarrow \frac{V_s(p)}{V_e(p)} = \frac{1}{\left(1 + \frac{L}{R}\,p\right)} \Rightarrow \boxed{\tau = L/R} \Leftrightarrow \frac{1}{1+\tau p}$$

Exemple de système du 2ème Ordre

$$V_e(t) = R\,i(t) + L\frac{di(t)}{dt} + \underbrace{\frac{1}{C}\int i(t)\,dt}_{V_s}$$



$$i(t) = C\frac{dV_s(t)}{dt}$$

$$V_e(t) = R.C\frac{dV_s(t)}{dt} + LC\frac{d^2V_s(t)}{dt^2} + V_s(t)$$

TP

$$\Rightarrow V_e(p) = RC\,pV_s(p) + LC\,p^2V_s(p) + V_s(p)$$

$$V_e(p) = V_s(p)\left[RCp + LCp^2 + 1\right]$$

$$T(p) = \frac{S(p)}{E(p)} = \frac{V_s(p)}{V_e(p)} = \frac{1}{LCp^2 + RCp + 1}$$

sys du 2ème ordre $= \dfrac{K}{p^2 + 2\eta\omega_n p + \omega_n^2}$

$$\Rightarrow T(p) = \frac{1}{LC\left[p^2 + \frac{R}{L}p + \frac{1}{LC}\right]}$$

$$= \frac{1/LC}{p^2 + \frac{R}{L}p + \frac{1}{LC}} \;;$$

$$\begin{cases} 2\eta\omega_n = \dfrac{R}{L} \;; \quad \omega_n^2 = \dfrac{1}{LC} \\ K = \dfrac{1}{LC} \qquad \Rightarrow \omega_n = \dfrac{1}{\sqrt{LC}} \\ \eta = \dfrac{R}{2}\sqrt{\dfrac{C}{L}} \end{cases}$$