Corrigé

Filière : ELT

EPREUVE : Physique Appliquée (Automatique)

1°) Déterminer les fonctions de transfert

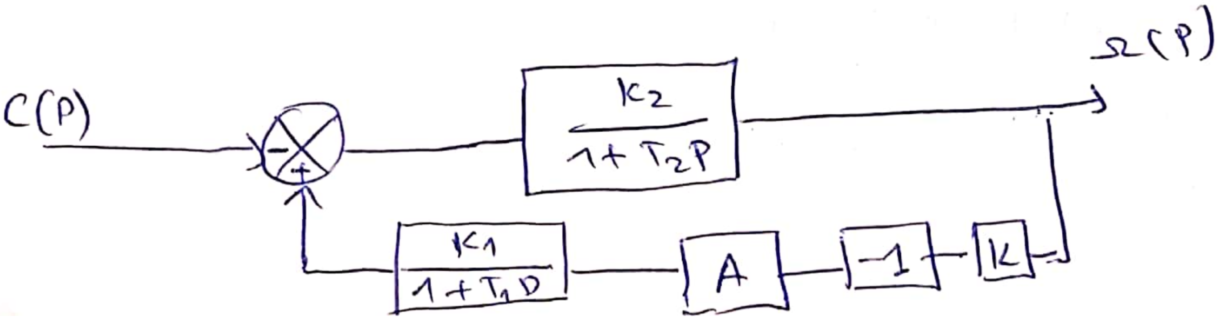
• $$\left.\frac{\Omega(P)}{V_c(P)}\right|_{C(P)=0} = \frac{A \times \frac{K_1}{1+T_1 P} \times \frac{K_2}{1+T_2 P}}{1 + A \cdot K \frac{K_1}{1+T_1 P} \times \frac{K_2}{1+T_2 P}}$$

$$\left.\frac{\Omega(P)}{V_c(P)}\right|_{C(P)=0} = \frac{A K_1 K_2}{(1+T_1 P)(1+T_2 P) + A K_1 K_2 K}$$

$$\boxed{\left.\frac{\Omega(P)}{V_c(P)}\right|_{C(P)=0} = \frac{5A}{0{,}5A + (1+P)(1+2P)}}$$

4 pts

• $$\left.\frac{\Omega(P)}{C(P)}\right|_{V_c=0} = \ ?$$



$$\left.\frac{\Omega(P)}{C(P)}\right|_{V_c=0} = - \frac{\dfrac{K_2}{1+T_2P}}{1+\dfrac{K_2}{1+T_2P}\times\dfrac{K_1}{1+T_1P}\times A\times K}$$

$$\left.\frac{\Omega(P)}{C(P)}\right|_{V_c=0} = - \frac{K_2(1+T_1P)}{(1+T_1P)(1+T_2P)+AK_1K_2K}$$

$$\boxed{\left.\frac{\Omega(P)}{C(P)}\right|_{V_c=0} = - \frac{0,4(1+P)}{(1+P)(1+2P)+0,5A}}$$

4 pts

- $\Omega(P) = f(V_c(P)\,;\,C(P))$

$$\boxed{\Omega(P) = \frac{5A\cdot V_c(P) - 0,4(1+P)\,C(P)}{(1+P)(1+2P)+0,5A}}$$

3 pts

2°) Determinons A pour $m = \frac{\sqrt{2}}{2}$

$D(P) = (1+P)(1+2P)+0,5A$

$D(P) = 1+0,5A+3P+2P^2$

$$D(P) = 1+0{,}5A\left(1+\frac{3}{1+0{,}5A}P+\frac{2}{1+0{,}5A}P^2\right)$$

$D(P)$ est de la forme $D(P) = 1+\frac{2m}{w_0}P+\frac{1}{w_0^2}P^2$

$$\begin{cases} \dfrac{2m}{w_0} = \dfrac{3}{1+0{,}5A} \\ \dfrac{2}{1+0{,}5A} = \dfrac{1}{w_0^2} \end{cases} \Rightarrow \begin{cases} 2m = \dfrac{3w_0}{1+0{,}5A} \\ w_0^2 = \dfrac{1+0{,}5A}{2} \end{cases}$$

$$4m^2 = \frac{9w_0^2}{(1+0{,}5A)^2} \Rightarrow 4m^2 = \frac{9\left(\frac{1+0{,}5A}{2}\right)}{(1+0{,}5A)^2}$$

$$4m^2 = \frac{9}{2}\,\frac{1}{1+0{,}5A} \Rightarrow A = \frac{\frac{9}{2}\times\frac{1}{4m^2}-1}{0{,}5}$$

$$\boxed{A = 2{,}5}$$

6 pts

3°) Déterminons $\Omega(P)$ et $w(t)$

$$\frac{\Omega(P)}{C(P)} = -\frac{0{,}4(1+P)}{0{,}5A+1+3P+2P^2} \Rightarrow \Omega(P) = \frac{-0{,}4(1+P)}{0{,}5A+1+3P+2P^2}\times\frac{1}{P}$$

$$\boxed{\Omega(P) = -\frac{0{,}4(1+P)}{2{,}25+3P+2P^2}\times\frac{1}{P}}$$

2 pts

$$\Omega(P) = -\frac{0{,}4}{P(2{,}25+3P+2P^2)} - \frac{0{,}4}{2{,}25+3P+2P^2}$$

$$\Omega(P) = -\frac{0{,}2}{P(1{,}125+1{,}5P+P^2)} - \frac{0{,}2}{1{,}125+1{,}5P+P^2}$$

$$\Omega(P) = -0{,}177\frac{1{,}125}{P(1{,}125+1{,}5P+P^2)} - 0{,}177\frac{1{,}125}{1{,}125+1{,}5P+P^2}$$

$$\boxed{w(t) = -0{,}177\left[1-1{,}41e^{-0{,}75t}\cdot\sin(0{,}749t+\arccos 0{,}707)+1{,}498e^{-0{,}75t}\cdot\sin(0{,}749\cdot t)\right]}$$

3 pts

$$\lim_{P\to 0} P\Omega(P) = w(+\infty)$$

$$\boxed{w(+\infty) = \lim_{P\to 0} P\Omega(P) = -\frac{0{,}4}{1+0{,}5A}}$$

4 pts

3-1 Etude de la stabilité

Soit $D(P) = 2P^2+3P+1+0{,}5A$ le polynôme caractéristique

Etudions la stabilité par critère Routh

p^2	2	$1+0{,}5A$
p^1	3	0
p^0	$1+0{,}5A$	0

le système est stable $1+0{,}5A > 0 \Rightarrow \boxed{A > -2}$

.5pts

4°) L'erreur $\varepsilon(P)$

• pour $C(P) = 0$

$$\varepsilon(P) = V_c(P) - k\,\Omega(P)$$

avec $\Omega(P) = \dfrac{5A}{0{,}5A + (1+P)(1+2P)} V_c(P)$

$$\varepsilon(P) = V_c(P) - \frac{k\,5A}{0{,}5A + (1+P)(1+2P)} V_c(P)$$

$$\boxed{\varepsilon(P) = \frac{(1+P)(1+2P)}{0{,}5A + (1+P)(1+2P)} V_c(P)}$$

3pts

• pour $V_c(P) = 0$

$$\varepsilon(P) = -k\,\Omega(P)$$

$$\boxed{-\varepsilon(P) = \frac{0{,}04(1+P)}{0{,}5A + (1+P)(1+2P)} C(P)}$$

3pts

- $\varepsilon(p) = f(V_c(p); c(p))$

$$\boxed{\varepsilon(p) = \frac{(1+p)(1+2p)V_c(p) + 0{,}04(1+p)c(p)}{0{,}5A + (1+p)(1+2p)}}$$

3pts