CORRIGE du D.S de S2I : DEUXIEME PROBLEME

Q1] voir . D.R . Page 7 .

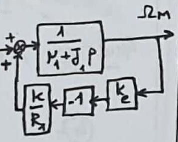
Q2] ⓐ $H_{BF}(p) = \frac{\Omega_M}{U_c}(p) = \frac{\frac{K}{R_1}\cdot\frac{1}{J_{mot}\cdot p}}{1+\frac{KK_e}{R_1}\cdot\frac{1}{J_{mot}\cdot p}}$

$$H_{BF}(p) = \frac{1/K_e}{1+\frac{R_1 J_m}{KK_e}p}$$

ⓑ $\omega_m(\infty) = \lim_{p\to 0} p\cdot\Omega_m(p) = \lim_{p\to 0} p\cdot\frac{U_c}{p}\cdot H_{BF}(p) = \frac{U_c}{K_e}$

ⓒ D'après l'énoncé : $\omega_m(\infty) = \frac{U_c}{K} \Rightarrow K_e = K$

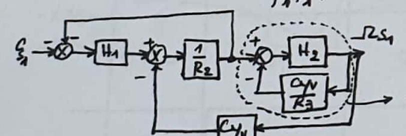
Q3] $U_c = 0$, le schéma bloc devient :



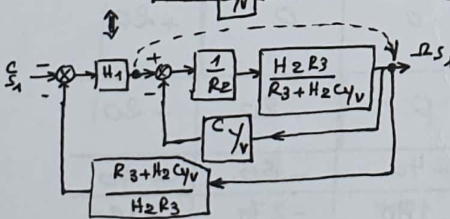
$$H_1(p) = \frac{-\frac{1}{\mu_1+J_1 p}}{1-\left(-\frac{KK_e}{R_1}\cdot\frac{1}{\mu_1+J_1 p}\right)} = \frac{\Omega_M}{C_p+C_{S_1}}(p)$$

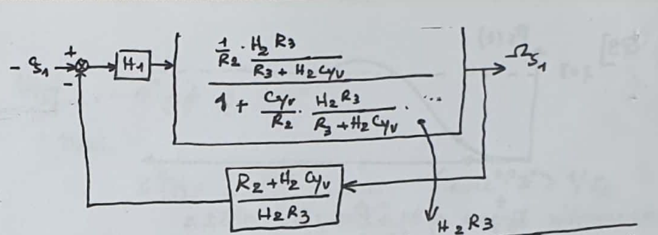
$$H_1(p) = \frac{-R_1}{\mu_1 R_1 + KK_e}\cdot\frac{1}{1+\frac{J_1 R_1}{\mu_1 R_1+KK_e}p}$$

Q4]



$$\frac{H_2}{1+\frac{H_2 C_{yv}}{R_3}} = \frac{H_2 R_3}{R_3+H_2 C_{yv}}$$





$$= \frac{H_2 R_3}{R_2(R_3+H_2 C_{yv}) + C_{yv} H_2 R_3}$$

D'où : $F_1(p) = \frac{\Omega_{S_1}}{C_{S_1}}(p) = -\frac{\frac{H_1 H_2 R_3}{(R_2(R_3+H_2 C_{yv})+C_{yv}\cdot H_2 R_3)}}{1+\frac{H_1 H_2 R_3}{(R_2(R_3+H_2 C_{yv})+C_{yv} H_2 R_3)}\cdot\frac{R_2+H_2 C_{yv}}{H_2 R_3}}$

$$F_1(p) = \frac{-H_1 H_2^2 R_3^2}{[R_2(R_3+H_2 C_{yv})+C_{yv} H_2 R_3] H_2 R_3 + H_1 H_2 R_3 (R_2+H_2 C_{yv})}$$

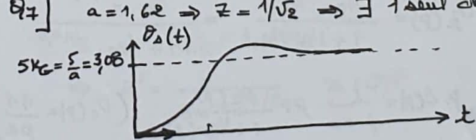
Q5] $G(p) = \frac{3{,}24/3{,}24\cdot a}{1+\frac{3{,}24}{3{,}24a}p+\frac{1}{3{,}24a}p^2} = \frac{1/a}{1+\frac{1}{a}p+\frac{1}{3{,}24a}\cdot p^2}$

soit : $K_G = \frac{1}{a}$; $\omega_n = \sqrt{3{,}24a}$ et $z = \frac{1}{2}\sqrt{\frac{3{,}24}{a}}$

Q6] syst. rapide $\Rightarrow z = \frac{1}{\sqrt{2}}$

soit alors : $\frac{1}{2}\sqrt{\frac{3{,}24}{a}} = \frac{1}{\sqrt{2}} \Rightarrow a = \frac{3{,}24}{2} = 1{,}62$

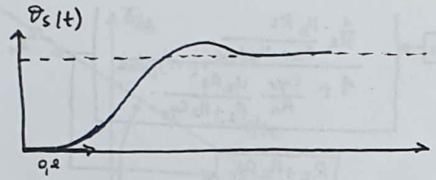
Q7] $a = 1{,}62 \Rightarrow z = 1/\sqrt{2} \Rightarrow \exists$ 1 seul dépassement



Q8] $z = \frac{1}{\sqrt{2}} \longrightarrow$ Abaque $\longrightarrow T_{5\%}\cdot\omega_n = 3$

donc : $T_{5\%} = \frac{3}{\omega_n} = \frac{3}{\sqrt{3{,}24\cdot a}} = \frac{3}{\sqrt{3{,}24\times 1{,}62}} \simeq 1{,}31$ s

Q9]



$T^*_{5\%} = 1,31 + \text{Retard} = 1,51\,s$

Q10] ⓐ- $\varepsilon(p) = \dfrac{\theta_c(p)}{1 + H_{BO}(p)}$

ⓑ- syst. à retour unitaire, donc:

$$\frac{\theta_s}{\theta_e}(p) = \frac{H_{BO}}{1+H_{BO}} = G(p)$$

donc: $H_{BO}(p) = \dfrac{G(p)}{1-G(p)} = \dfrac{1}{p\left(1+\dfrac{p}{3,24}\right)}$

ⓒ- $\varepsilon_s = \lim\limits_{t\to\infty} \varepsilon(t) = \lim\limits_{p\to 0} p.\varepsilon(p)$ (avec: $\theta_c(p) = \dfrac{1}{p}$).

$$\varepsilon_s = \lim_{p\to 0} p.\frac{1/p}{1+H_{BO}(p)} = 0$$

Q11] Retard = 0,2 s → F.T du Retard est: $e^{-0,2p} = H_{Ret}(p)$

Donc: $G_R(p) = \dfrac{H_{BO}.H_{Ret}}{1+H_{BO}.H_{Ret}} = \dfrac{H_{BO}.e^{-0,2p}}{1+H_{BO}.e^{-0,2p}}$.

Q12] $\varepsilon_v = \lim\limits_{p\to 0} p.\varepsilon(p) = \lim\limits_{p\to 0} p.\dfrac{\theta_c(p)}{1+H_{BO}(p)}$ $\left(\theta_c(p) = \dfrac{0,1}{p^2}\right)$

$\varepsilon_v = 0,1$

Q13] $H_{BO}(p) = \dfrac{4}{p(p+4)} = \dfrac{1}{p(1+\frac{1}{4}p)}$.

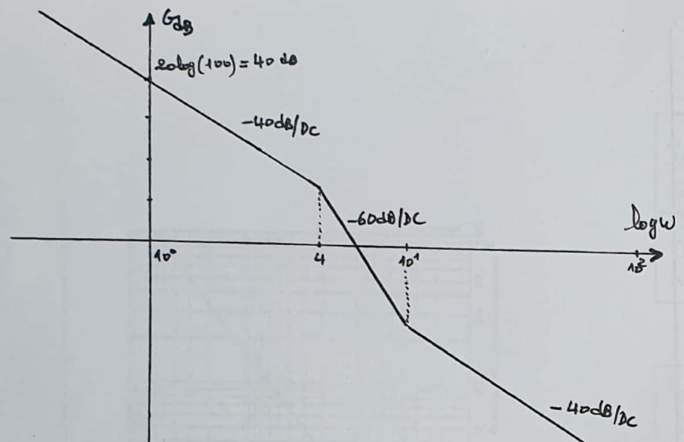
ω	0	$\frac{1}{0,25}=4$	+∞
$\frac{1}{p}$	−20	−20	
$\frac{1}{1+0,25p}$	0	−20	
G_{dB}	−20 dB/dc	−40 dB/dc	
ϕ	−90°	−180°	

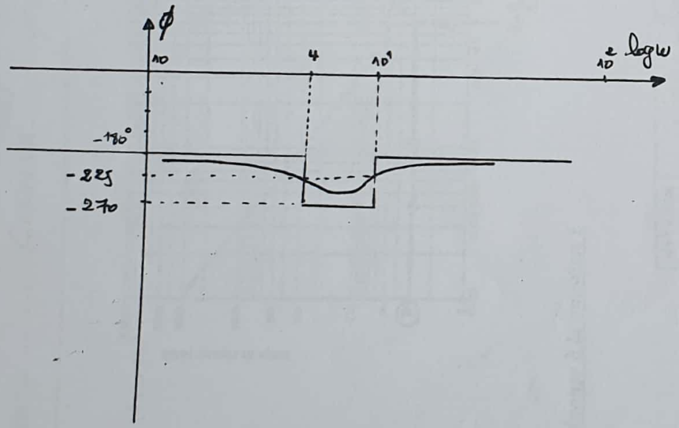
Tracé : voir DR.

Q14] ⓐ- $F(p) = C(p).H_{BO}(p) = \dfrac{K_c}{T_c}.\dfrac{1+T_c p}{p^2(1+\frac{1}{4}p)}$

ⓑ- $F(p) = 100.\times\left(\dfrac{1}{1+0,1p}\right)^{-1}.\left(\dfrac{1}{(1+0,25p)}\right)\times\dfrac{1}{p^2}$

ω	0	4	10	∞
100	0	0	0	
$\left(\frac{1}{p}\right)^2$	−40	−40	−40	
$\left(\frac{1}{1+0,1p}\right)^{-1}$	0	0	+20	
$\frac{1}{1+0,25p}$	0	−20	−20	
G_{dB}	−40	−60	−40	
Φ	−180	−270	−180	





Q15] $0° \leq \phi \leq -180°$

Donc :

$$G^*(p) = \frac{K_G^*}{1 + \frac{2Z^*}{\omega_n^*}p + \frac{p^2}{\omega_n^{*2}}} \quad \left(\text{avec } Z^* \geq 1/\sqrt{2} \text{ car } \nexists \text{ résonance}\right)$$

$\underline{K_G^*}$ est/ : $20 \log K_C^* = 0 \text{ dB} \Rightarrow K_G^* = 1$

ω_n^* est/ $\phi(\omega_n^*) = -90° \xrightarrow[\text{phase}]{\text{courbe de}} \omega_n^* = 100 \text{ rd/s}$

Z^* est/

$$|G^*(j\omega_n^*)| = \frac{1}{\sqrt{\left[1-\left(\frac{\omega_n^*}{\omega_n^*}\right)^2\right]^2 + \left(\frac{2Z^*\omega_n^*}{\omega_n^*}\right)^2}} = \frac{1}{2Z^*}$$

Or : pour $\omega_n^* \xrightarrow[\text{gain}]{\text{courbe de}} G_{dB}(\omega_n^*) = -3 \text{ dB}$

Donc : $20 \log \left(\frac{1}{2Z^*}\right) = -3 \text{ dB}$

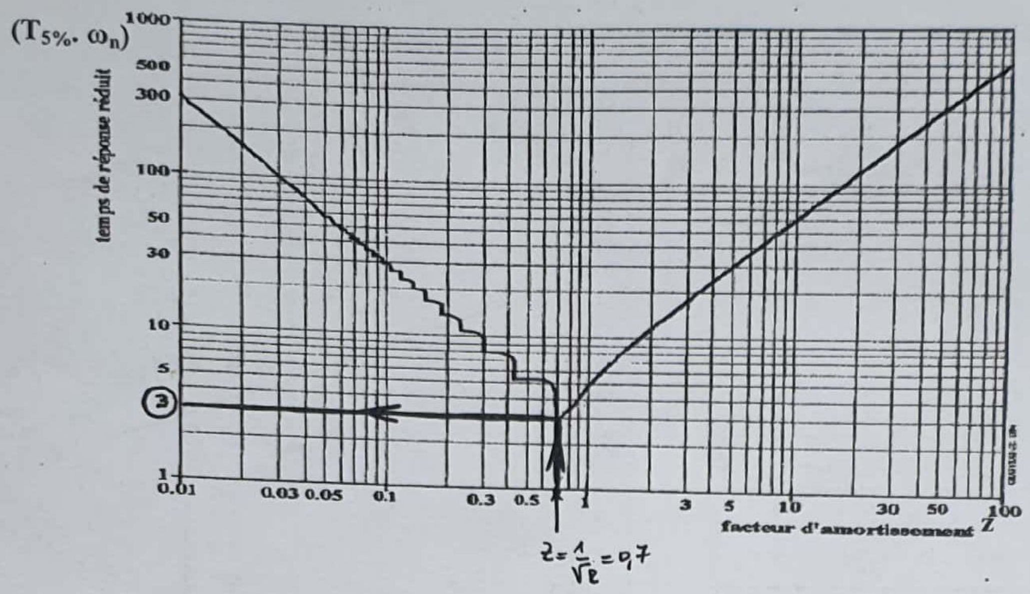
soit

$$\log \left(\frac{1}{2Z^*}\right) = -3/20$$

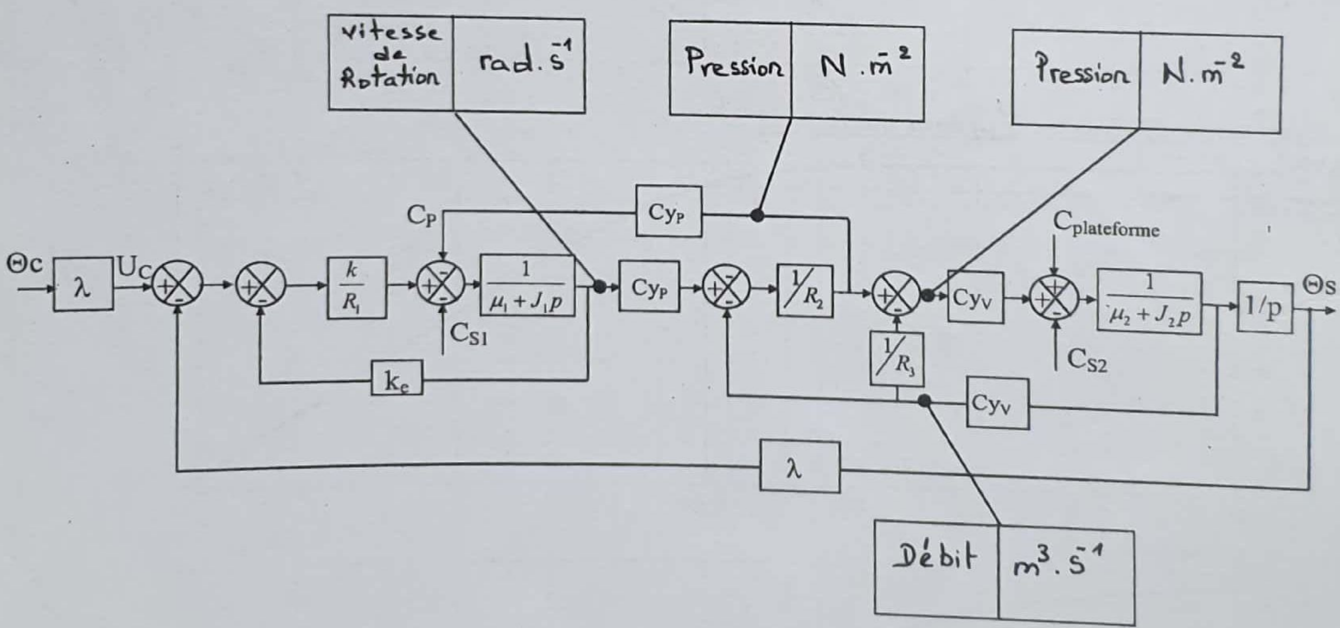
$$\frac{1}{2Z^*} = 10^{-3/20}$$

$$\Rightarrow Z^* = \frac{1}{2 \times 10^{-3/20}} \approx 0{,}7.$$

Nom : ....CORRIGE.................



Réponse à la question 1



Nom : .... CORRIGE ....

Réponse à la question 13

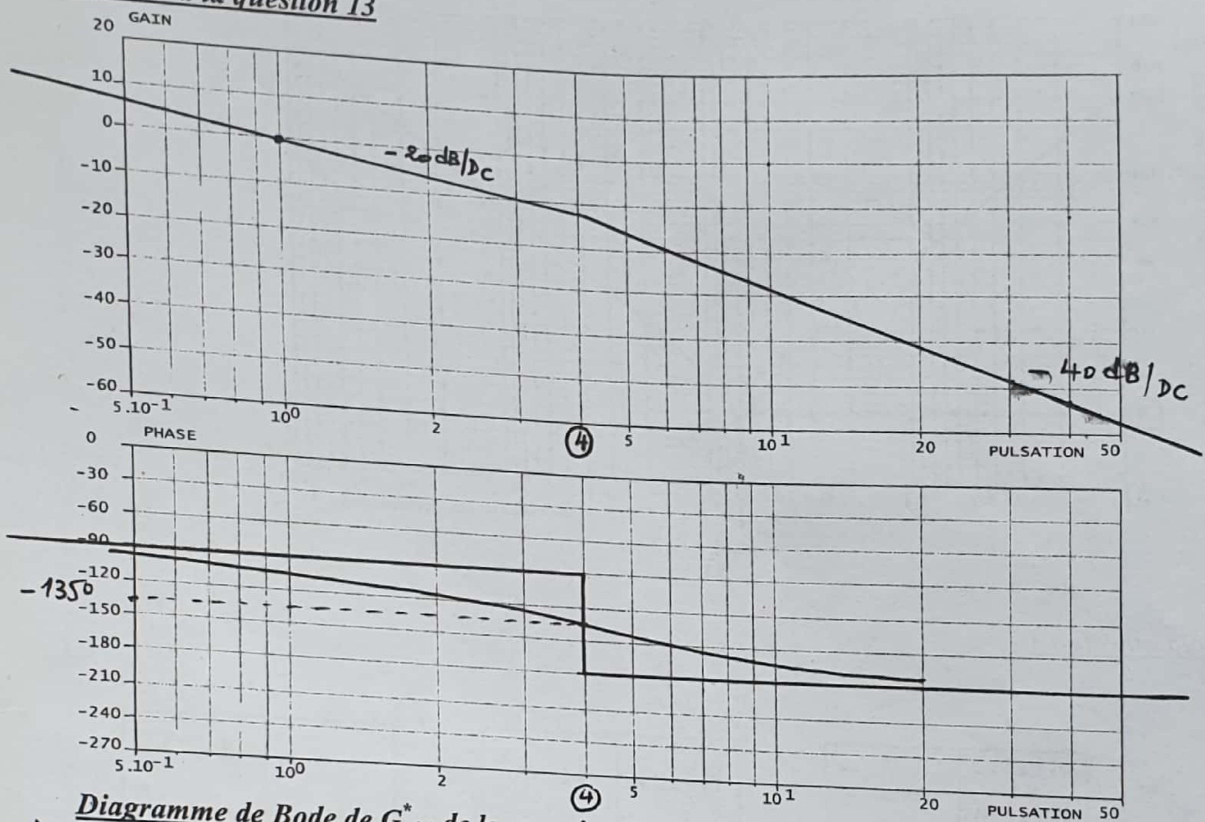


Diagramme de Bode de $G^{*}_{(p)}$ de la question 15