Q1/: DAOUDI IMANE

$$CD = \frac{2K_T}{r \cdot D_p \cdot M_{eq} P (R + LP)}$$

$$CR = \frac{2K_E}{r \cdot D_p}$$

$$\boxed{H(P) = \frac{\dfrac{2K_T}{r \cdot D_p \cdot M_{eq} \cdot P(R+LP)}}{1 + \dfrac{4K_E \cdot K_T}{r^2 \cdot D_p^2 \cdot M_{eq} \cdot P(R+LP)}}}$$

Q2/: forme canonique:

$$H(P) = \frac{2K_T \cdot r \cdot D_p}{r^2 \cdot D_p^2 \cdot M_{eq} P (R + LP) + 4K_E \cdot K_T}$$

$$= \frac{2K_T \cdot r \cdot D_p}{r^2 \cdot D_p^2 \cdot M_{eq} \cdot L P^2 + r^2 D_p^2 M_{eq} R P + 4K_E K_T}$$

$$\boxed{H(P) = \frac{\dfrac{r \cdot D_p}{2K_E}}{1 + \dfrac{r^2 \cdot D_p^2 M_{eq} \cdot R}{4K_E K_T} P + \dfrac{r^2 D_p^2 M_{eq} L}{4K_E K_T} P^2}}$$

- $W_n = \sqrt{\dfrac{4K_E K_T}{r^2 D_p^2 M_{eq} L}}$, $G = \dfrac{r D_p}{2K_E}$

$$\frac{2z}{W_n} = \frac{r^2 \cdot D_p^2 \cdot M_{eq} \cdot R}{4K_E K_T}$$

$$z = \frac{1}{2} \times \frac{r^2 \cdot D_p^2 \cdot M_{eq} \cdot R}{4K_E K_T} \times \sqrt{\frac{4K_E \cdot K_T}{r^2 \cdot D_p^2 \cdot M_{eq} \cdot L}}$$

$$z = \frac{1}{2} \sqrt{\frac{r^2 \cdot D_p^2 M_{eq} R^2}{4K_E K_T \cdot L}}$$

$$z = \frac{r D_p R}{4} \sqrt{\frac{M_{eq}}{K_E K_T L}}$$

$G = 0{,}031$

$z = 2{,}37 \Rightarrow z > 1$

$W_m = 45{,}25$ rad/s

Q3/:

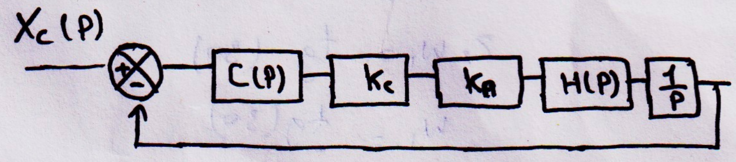
on utilise le théorème de Pôle dominns,

on remarque $\tau_2 \gg \tau_1$

d'où : $H(P) = \dfrac{G}{1 + \tau_2 P}$

$$H(P) = \frac{0{,}03125}{1 + 0{,}1P}$$

Simplification de schéma :



Q4/:

$$H_{BO}(P) = C(P) \cdot K_c \cdot K_a \cdot H(P) \cdot \tfrac{1}{P}$$

$$H_{BO}(P) = \frac{K_c K_a \cdot G}{P(1 + \tau_2 P)} \Rightarrow \boxed{MG = +\infty}$$

Q5/:

- Marge de gain : $MG = +\infty$
- Marge de phase :

$MP = -145 + 180 = 35°$ $\Rightarrow k = 1$

Puisque $MP > 0 \Rightarrow$ système stable

Q6/:

$$H_{BO}(P) = \frac{K \cdot K_a \cdot K_c \cdot G}{P(1 + \tau_2 P)}$$

$$H_{BO}(j\omega) = \frac{k.k_a.k_c.G}{j\omega(1+\tau_2 j\omega)}$$

* **module** :

$$|H_{BO}(j\omega)| = \frac{k.k_a.k_c G}{\omega\sqrt{1+(\tau\omega)^2}}$$

+ **Argument** :

$$\mathrm{Arg}(H_{BO}(j\omega)) = -90 - \mathrm{arctg}(\tau_2\omega)$$

$$\begin{cases} MP = 180 + \mathrm{Arg}(H_{BO}(j\omega_1)) \\ \text{à } \omega_1 : \ |H_{BO}(j\omega_1)| = 1 \end{cases}$$

On a.

$$MP = 180 - 90 - \mathrm{arctg}(\tau_2\omega_1) = 60$$

$$\Leftrightarrow \mathrm{Arctg}(\tau_2\omega_1) = 30$$

$$\tau_2\omega_1 = tg(30)$$

$$\omega_1 = \frac{tg(30)}{\tau_2}$$

$$\omega_1 = 5{,}77 \text{ rad/s}$$

on $|H_{BO}(j\omega_1)| = 1$

$$k \frac{k_a k_c G}{\omega_1\sqrt{1+(\tau_2\omega_1)^2}} = 1$$

$$k = \frac{\omega_1\sqrt{1+(\tau_2\omega_1)^2}}{k_a.k_c.G}$$

d'où : $k = 0{,}34$

Q7/

on $H_{BO}(P) = \dfrac{k.k_a.k_c G}{P(1+\tau P)}$

puisque H_{BO} possède une intégration $\Rightarrow \varepsilon_s = 0$

le système est précis.

$\varepsilon_s < 1\%$.

Q8/

$$F(P) = \frac{H_{BO}(P)}{1 + H_{BO}(P)}$$

$$= \frac{k\,k_a\,k_c\,G}{P(1+\tau P) + k.k_a k_c G}$$

$$= \frac{1}{1 + \frac{1}{k k_a k_c G} P + \frac{\tau}{k k_a k_c G} P^2}$$

$$\omega_n = \sqrt{\frac{k_a k_c.k.G}{\tau}}$$

$$\frac{2z}{\omega_n} = \frac{1}{k k_a k_c G}$$

$$z = \frac{1}{2}\sqrt{\frac{1}{k_a k_c k.G.\tau}}$$

$z = 0{,}6$, $\omega_n = 8{,}24$ rad/s

Q9/

pour $z = 0{,}6 \Rightarrow tr_{5\%} \times \omega_n = 5{,}2$

$$tr_{5\%} = \frac{5{,}2}{8{,}24} = 0{,}63 \text{ s}$$

$tr_{5\%} = 0{,}63\text{ s} < 1\text{ s}$

il respect l'exigence sur la rapidité.