Correction DS de SI, MP, déc 24

Q2 Exigence 1.5 : réversibilité

Q3 1] Rotor ; 2] vis écrou 3] Galet came 4] Codeur 5] Position moteur

6] P électrique 7] P mécanique (rotation) 8] P mécanique translation

Q4 $\vec{\Omega}_{2/0} = \vec{0}$

Q7 $d = 2(y_A + x_B \sin\alpha + y_B \cos\alpha)$

Q8 $\cos\alpha \simeq 1$; $\sin\alpha \simeq \alpha$; $a = -190 \text{ mm rad}^{-1}$; $b = 8{,}6 \text{ mm}$

Q9 Fermeture géo en <u>projection sur $\vec{y_2}$</u> $\Rightarrow d_1 = x_E$

$d_2 = y_C - y_A$; $d_3 = R_g$; $d_4 = x_C$

Q10 Courbe $\Rightarrow K_D = 22{,}5 \text{ mm.rad}^{-1}$

Q11

$$\xrightarrow{\Delta\theta_3} \boxed{\frac{pas}{2\pi}} \xrightarrow{\Delta x_D} \boxed{\frac{1}{K_D}} \xrightarrow{\Delta\alpha} \boxed{a} \xrightarrow{\Delta d}$$

$\Delta\theta_3 = \dfrac{2\pi}{10^{14}}$ (codeur) $\qquad \Delta d = \dfrac{a \times pas}{2\pi K_D}\Delta\theta_3 = 0{,}66 \,\mu\text{m}$

Q12 $Rsg \Rightarrow \vec{v}(I \in 4/1) = \vec{0} = \underbrace{\vec{v}(I \in 4/0)}_{\text{par } C} - \underbrace{\vec{v}(I \in 1/0)}_{\text{par } A}$

On projette sur $\vec{x_2}$

$$\Rightarrow \omega_{40} = \frac{\dot\alpha\,(K_D \cos(\alpha+\beta) - x_E \sin\alpha)}{R_g} = \frac{\dot\alpha\,(K_D - \sqrt{3}.x_E)}{2.R_g}$$

Q13

$$E_c(\Sigma/0) = 2 \times \frac{1}{2} I_1 \dot\alpha^2 + \frac{1}{2} m_2 \dot x_D^2 + \frac{1}{2} I_3 \dot\theta_3^2 + $$
$$+\, 2 \times \left(\frac{1}{2} m_4 \dot x_D^2 + \frac{1}{2} I_4 \omega_{40}^2\right)$$

Q14 $\dot\alpha = \dfrac{pas}{2\pi K_D}\dot\theta_3$; $\dot x_D = \dfrac{pas}{2\pi}\dot\theta_3$; $\omega_{40} = K_G \dot\alpha = \ldots$

$$E_c(\Sigma/0) = \frac{1}{2}\left[2 I_2 \left(\frac{pas}{2\pi K_D}\right)^2 + (m_2 + 2m_4)\left(\frac{pas}{2\pi}\right)^2 + I_3 + 2 I_4 \left(\frac{K_G\, pas}{2\pi K_D}\right)^2\right]\dot\theta_3^2$$

Q15 <u>Puissances</u> : $P_{mot} = C_m.\dot\theta_3$; $P_{frott} = -f.\dot\theta_3^2$

$$P_{rappel} = -2 C_r \alpha \dot\alpha$$

(2) $P_{objet\,1} = P(objet \to 1/0) = \vec{F}_{objet\,1} \cdot \vec{v}(B \in 1/0)$

$\vec{F}_{objet} = F_0 \vec{y_0}$

$\vec{AB} = x_B \vec{x_1} + y_B \vec{y_1}$

$\vec{v}(B \in 1/0) = x_B \dot{\alpha} \vec{y_1} - y_B \dot{\alpha} \vec{x_1}$

$P_{objet\,1} = F_0 \dot{\alpha} (x_B \cos\alpha - y_B \sin\alpha) \simeq F_0 \dot{\alpha} x_B$

$P_{objet\,1'} = -F_0 \dot{\alpha}' x_B = F_0 \dot{\alpha} x_B$

$P_{objet} = 2 F_0 \dot{\alpha} x_B$

de même $P_{main} = -2 F_m \dot{\alpha} x_E$

Q16 $P_{int} = 0$

Q17 $J_{eq} \ddot{\theta}_3 \dot{\theta}_3 = C_m \dot{\theta}_3 - f \dot{\theta}_3^2 \underbrace{- 2 C_1 \alpha \dot{\alpha} + 2 F_0 \dot{\alpha} x_B - 2 F_m \dot{\alpha} x_E}$

$\boxed{\dot{\alpha} = \frac{p_{es}}{2\pi K_D} \dot{\theta}_3}$

$-2 C_1 \left(\frac{p_{es}}{2\pi K_D}\right)^2 \theta_3 \dot{\theta}_3 + \cancel{2 F_0 x_B \left(\frac{p_{es}}{2\pi K_D}\right)}$

$+ 2 (F_0 x_B - F_m x_E) \left(\frac{p_{es}}{2\pi K_D}\right) \dot{\theta}_3$

$\Rightarrow J_{eq} \ddot{\theta}_3 + f \dot{\theta}_3 + 2 C_1 \left(\frac{p_{es}}{2\pi K_D}\right)^2 \theta_3 = C_m + 2 (F_0 x_B - F_m x_E) \frac{p_{es}}{2\pi K_D} \dot{\theta}_3$

~~Q18~~ $J_{eq} \ddot{\theta}_3 + f_{eq} \dot{\theta}_3 + C_{eq} \theta_3 = - l_m F_m + l_0 F_0 + C_m$

Q18 <u>Pince bloquée sans objet</u> : $\theta_3 = cte$ et $F_0 = 0$

$\Rightarrow C_m = C_{eq} \theta_3 + l_m F_m$

Q19 <u>Pince bloquée sans action utilisateur</u> : $\theta_3 = cte$ et $F_m = 0$

$\Rightarrow C_m = C_{eq} \theta_3 - l_0 F_0$

Q20

Q9 $\vec{OA} + \vec{AE} + \vec{EI} = \vec{OC} + \vec{CI}$

$$y_A \vec{y_0} + x_E \vec{x_1} + x_1 \vec{x_2} = x_D \vec{x_0} + x_C \vec{x_0} + y_C \vec{y_0} + R_g \vec{y_2}$$

x_1 et x_D variables, il faut éliminer x_1

On projette sur $\vec{y_2}$

$$y_A \cos(\alpha + \beta) - x_E \sin\beta = - x_D \sin(\alpha+\beta) - x_C \sin(\alpha+\beta)$$
$$+ y_C \cos(\alpha+\beta) + R_g$$

$$x_D = \frac{x_E \sin\beta + (y_C - y_A)\cos(\alpha+\beta) + R_g}{\sin(\alpha+\beta)} - x_C$$

Q10 $x_D = K_D . \alpha \Rightarrow K_D = \frac{\Delta x_D}{\Delta \alpha} = \frac{1}{0,045} = 22,2$ mm/rad

Q11 $$\theta_3 \longrightarrow \boxed{\frac{pas}{2\pi}} \xrightarrow{x_D} \boxed{\frac{1}{K_D}} \xrightarrow[\Delta\alpha]{(\alpha)} \boxed{a} \xrightarrow[\Delta d]{(d)}$$

$$\alpha = \frac{1}{K_D} x_D = \frac{pas}{2\pi K_D} \theta_3$$

Codeur : $2\pi \rightarrow 10^{12}$ position

$\Delta\theta_3 = \frac{2\pi}{10^{12}} \rightarrow 1$ position

$$\Delta\alpha = \frac{pas}{2\pi K_D} \frac{2\pi}{10^{12}} = \frac{pas}{K_D . 10^{12}}$$

$$\boxed{\cancel{\Delta\alpha = \frac{1,1}{22,2 \times 10^{12}}}} \qquad \Delta d = a \Delta\alpha = \frac{a \times pas}{K_D . 10^{12}} = 0,66 \text{ nm}$$

Q12 $\quad \vec{v}(I \in 5/1) = \vec{0} = \vec{v}(I \in 5/0) - \vec{v}(I \in 1/0)$

$$\vec{v}(I \in 5/0) = \vec{v}(C \in 5/0) + \vec{\Omega}_{5/0} \wedge \vec{CI}$$
$$= \dot{x}_D \vec{x}_0 + \omega_{51} \vec{z}_0 \wedge R_g \vec{y}_2$$
$$= \dot{x}_D \vec{x}_0 - \omega_{51} R_g \vec{x}_2$$

$$\vec{v}(I \in 1/0) = \vec{v}(A \in 1/0) + \vec{\Omega}_{1/0} \wedge \vec{AI}$$
$$= \vec{0} + \dot{\alpha} \vec{z}_0 \wedge (x_E \vec{x}_1 + x_1 \vec{x}_2)$$
$$= \dot{\alpha}(x_E \vec{y}_1 + x_1 \vec{y}_2)$$

$$\Rightarrow \dot{x}_D \vec{x}_0 - \omega_{51} R_g \vec{x}_2 = \dot{\alpha}(x_E \vec{y}_1 + x_1 \vec{y}_2)$$

Rem : $\omega_{51} = \omega_{50}$; x_1 variable ; on projette sur $\vec{x}_2$

$K_D \dot{\alpha}$ ''

$$\dot{x}_D \cos(\alpha + \beta) - \omega_{50} . R_g = \dot{\alpha} x_E \sin \alpha$$
$$\omega_{50} = \frac{-\dot{\alpha} x_E \sin \alpha + \dot{x}_D \cos(\alpha + \beta)}{R_g}$$

~~β, α petits~~ $\Rightarrow \omega_{50} = \dot{\alpha}\left(\frac{K_D \cos(\alpha + \beta) - x_E \sin \alpha}{R_g}\right)$

α petit
$\beta = \pi/3$ $\quad \Rightarrow \omega_{50} = \dot{\alpha} \dfrac{K_D - \sqrt{3}\, x_E}{2 R_g}$