1

Correction DS de SI, MP, déc 21, Trooper

Q1 $T_m = 8T_p + \frac{4L}{V} + \frac{3(L+l)}{V} \Rightarrow V = \frac{7L+3l}{T_m - 8T_p} = 0{,}89\ m/s$

Q2 chaine fonctionnelle ...

Q3 $V = r.\omega_{roue} = r\, k_r \omega_m = 0{,}15 \times \frac{1}{40} \times 3000 \frac{2\pi}{60} = 1{,}18\ m/s > 1\ m/s$

Q4 $D = (T - \delta t) \times V_{max} \Rightarrow \delta t = T - \frac{D}{V_{max}} = 0{,}9\ s$

Q12 $E_c = \frac{1}{2}(M + 6m)v^2$; $P_{mot} = 2C_m \omega_m$; $P_{pes} = -(M+6m)g.v \sin\alpha$

$TEC \Rightarrow (M+6m)\gamma v = 2C_m \frac{v}{k_t} - (M+6m) g\, v \sin\alpha$

$\Rightarrow M_{eq}\gamma = \frac{2}{k_t} C_m - (M+6m) g \sin\alpha$

$M_{eq} = M + 6m$
$r_{eq} = k_t/2$
$F_{req} = (M+6m) g \sin\alpha$

Q13 Phase 1 : $C_m = M_{eq}\gamma\, r_{eq} + r_{eq} F_{req}$

$C_m = 120 \times 1{,}1 \times 2.10^{-3} + 200 \times 2.10^{-3} = 0{,}264 + 0{,}4 = 0{,}664\ Nm$

Phase 2 : $C_m = 0{,}4\ Nm$ Phase 3 : $C_m = -0{,}264 + 0{,}4 = 0{,}136\ Nm$

Q14 $U_m = R_m i_m + k_m \omega_m \Rightarrow i_{m\,max} = \frac{U_m}{R_m} = 100\ A$

$C_m = k_m i_m = 0{,}2 \times 100 = 20\ Nm >> 0{,}664\ Nm$

Q15 $\vec{v}(A', g/0) = \vec{v}(A', g/1) + \vec{v}(A'; 1/0)$

$\vec{v}(A'; g/1) = \vec{v}(A, g/1) + \vec{A'A} \wedge \vec{\Omega}^{g}_{1} = \vec{0} + r\vec{z} \wedge \omega_g \vec{x_1} = r.\omega_g.\vec{y_1}$

$\vec{v}(A'; 1/0) = \vec{v}(O, 1/0) + \vec{A'O} \wedge \vec{\Omega}^{1}_{0} = V\vec{y_1} + (r\vec{z} + e\vec{x_1}) \wedge \dot{\theta}\vec{z} = (V - e\dot{\theta})\vec{y_1}$

$\Rightarrow \vec{v}(A'; g/0) = (r\omega_g + V - e\dot{\theta})\vec{y_1}$

$\vec{v}(B'; d/0) = (r\omega_d + V + e\dot{\theta})\vec{y_1}$

Q16 $Rsg \Rightarrow \begin{cases} r\omega_g + V - e\dot{\theta} = 0 \\ r\omega_d + V + e\dot{\theta} = 0 \end{cases} \Rightarrow \begin{cases} r(\omega_g + \omega_d) = 2V \\ V = -\frac{r}{2}(\omega_g + \omega_d) \end{cases}$

$\Rightarrow \begin{cases} r(\omega_g - \omega_d) - 2e\dot{\theta} = 0 \\ \dot{\theta} = \frac{r}{2e}(\omega_g - \omega_d) \end{cases}$

(2)

Q17

$V = -C_2(\omega_g + \omega_d)$

$V = V_c > 0 \Rightarrow \omega_g = \omega_d = -\dfrac{V}{2C_2}$

$V = -V_c < 0 \Rightarrow \omega_g = \omega_d = \dfrac{V}{2C_2}$

$\dot\theta = C_1(\omega_g - \omega_d)$

$\dot\theta = \omega_c > 0 \Rightarrow \omega_g = -\omega_d = \dfrac{\omega_c}{2C_1}$

$\dot\theta = -\omega_c < 0 \Rightarrow \omega_g = -\omega_d = -\dfrac{\omega_c}{2C_1}$

Q18 Arret 1 $\Rightarrow \omega_g = \omega_d = 0$

Rotation gauche $\Rightarrow \omega_g = \omega_1$ et $\omega_d = -\omega_1$

Transition $\Rightarrow$ after t_c

Arret 2 $\Rightarrow \omega_g = \omega_d = 0$

Avance $\Rightarrow \omega_g = \omega_d = \omega_2$

Transition $\Rightarrow$ if $l < l_c$

Arret 3 $\Rightarrow$ ..

Q19 Mécanisme à croix de Malte (type capsuleuse).

Q20 Pour soulever les pots $\Rightarrow$ Rotour R2

$\overrightarrow{\Omega_{3/0}} = 0$, les barres S_1 et S_2 restent //.

Q21 et **Q22** A NE PAS ABORDER

Q23 On isole le pot, TRS $\Rightarrow mg = T_1 + T_2 = 2T$.

Lois de Coulomb $\Rightarrow T = fN \Rightarrow mg = 2fN$

$\Rightarrow N = \dfrac{mg}{2f} = 166{,}6\ N$.

Q24 On isole la roue, TMS en O

$C = 2rN = 2r\dfrac{mg}{2f} = \dfrac{r}{f}mg \Rightarrow C_0 = \dfrac{r}{f}$

$C = C_0\, mg = 10{,}6\ Nm < 12\ Nm$

Q25 Position la plus défavorable $\Rightarrow$ 0 pot sur le plateau, bras en avant avec 1 pot

③ On isole le robot, TMS en D

(Q26)

$$-N_c \cdot \ell + \frac{Mg}{2}(b-a) - \frac{mg}{2} c = 0 \Rightarrow N_c = \frac{Mg(b-a) - mg \cdot c}{2\ell}$$

(Q27) $N_c = 0 \Rightarrow m = \frac{M(b-a)}{c}$

(Q28) TRD ⇒ (5) et (6) ; TMD en D ⇒ (7)

(Q29) On isole la roue, TMD au centre ⇒

$$\Rightarrow C_m = r \cdot T_D \Rightarrow T_D = \frac{C_m}{r}$$

(Q30) $\gamma = 1,1\ m.s^{-2}$; roue arrière libre ⇒ $T_c = 0$

$$(5) \Rightarrow T_D = \frac{M}{2}\gamma = 33\ N$$

$$(7) \Rightarrow N_c = \frac{(b-a)Mg + hM\gamma}{2\ell}$$

$$(6) \Rightarrow N_D = \frac{Mg}{2} - N_c = \frac{M(ag - h\gamma)}{2\ell} = 178\ N$$

$$\frac{T_D}{N_D} = 0,18 < f \Rightarrow \text{Pas de glissement.}$$

(Q31) Limite glissement ⇒ $T_D = f \cdot N_D = \frac{M}{2}\gamma \Rightarrow \gamma = \frac{2fN_D}{M}$

$$\gamma = 2,97\ m\,s^{-2}$$

Avec $\gamma = 2,97\ m\,s^{-2}$, $t_{accélération} = \frac{V}{\gamma} = \frac{1,1}{2,97} = 0,37\ s.$

(Q5) Avec les equations, on obtient : $\frac{R_m J}{2 k_m k_t} \cdot \frac{dv(t)}{dt} + \frac{k_m}{k_t} v(t) = u_m(t)$

$$v(t) = \alpha_0 \left(t - \tau_m + \tau_m e^{-t/\tau_m}\right) ; \frac{dv(t)}{dt} = \alpha_0 \left(1 - e^{-t/\tau_m}\right) ; u_m(t) = \frac{u_0}{St} \cdot t \cdot u(t)$$

$$\Rightarrow \frac{R_m J}{2 k_m k_t} \alpha_0 \left(1 - e^{-t/\tau_m}\right) + \frac{k_m}{k_t} \alpha_0 \left(t + \tau_m + \tau_m e^{-t/\tau_m}\right) = \frac{u_0}{St} t$$

$$\Rightarrow \frac{k_m}{k_t} \alpha_0 = \frac{u_0}{St} \Rightarrow \alpha_0 = \frac{u_0 k_t}{k_m St}$$

$$\Rightarrow \frac{R_m J}{2 k_m k_t} \alpha_0 - \frac{k_m}{k_t} \alpha_0 \tau_m = 0 \Rightarrow \tau_m = \frac{R_m J}{2 \cdot k_m^2}$$

(Q6) $T_m = 0{,}1$ s (retard entre Vconsigne et Vreel)

(Q7) $U_m = R_m I_m + k_m \Omega_m \Rightarrow I_m = \frac{U_m}{R_m} - \frac{k_m}{R}\Omega_m$.

$2C_m - C_r = Jp\,\Omega_m$; $C_m = k_m I_m$.

$$Jp\,\Omega_m = 2k_m I_m - C_r = 2k_m\frac{U_m}{R_m} - 2\frac{k_m^2}{R_m}\Omega_m - C_r$$

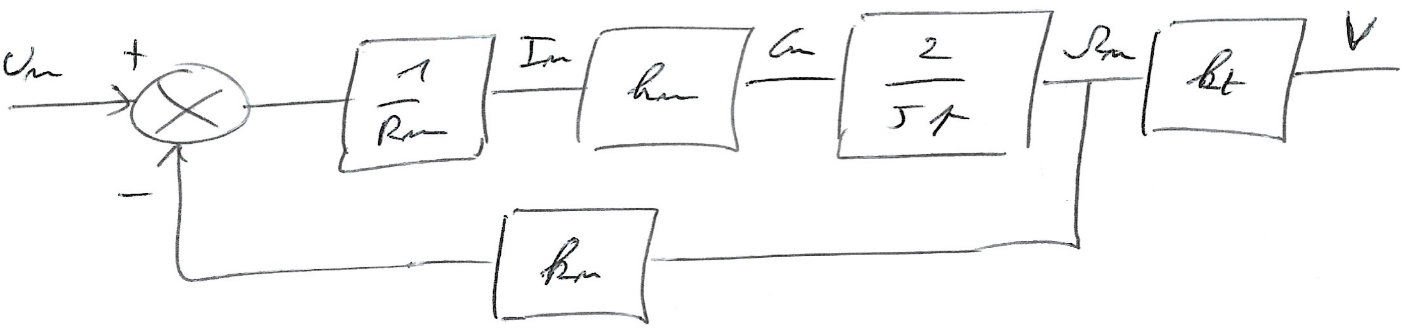
$$R_m J p\,\Omega_m = 2k_m U_m - 2k_m^2\Omega_m - R_m C_r$$

$$\Omega_m\left(R_m J p + 2k_m^2\right) = 2k_m U_m - R_m C_r$$

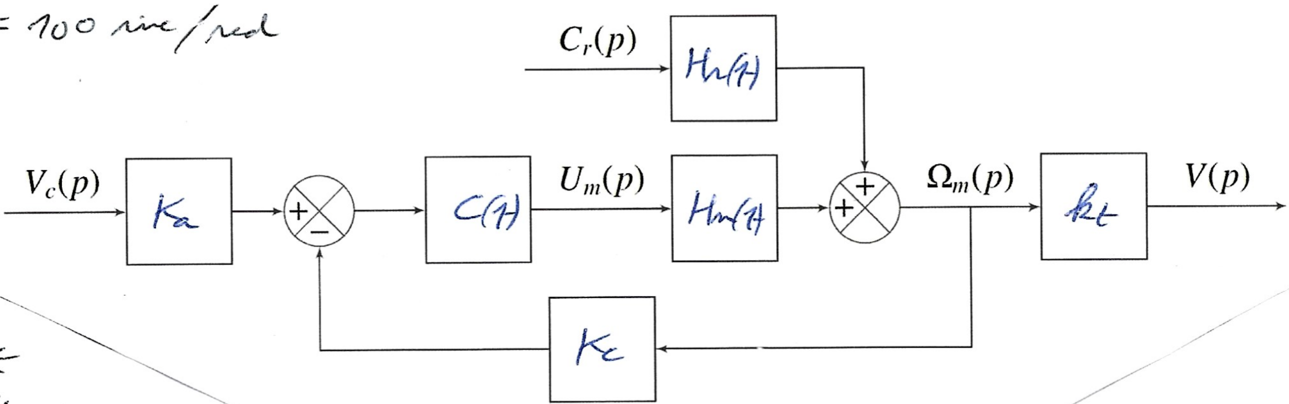
$$\Omega_m = \frac{2k_m}{R_m J p + 2k_m^2}U_m - \frac{R_m}{R_m J p + 2k_m^2}C_r$$

$$H_m = \frac{1/k_m}{1 + \frac{R_m J}{2k_m^2}p} \qquad H_r = \frac{\frac{R_m}{2k_m^2}}{1 + \frac{R_m J}{2k_m^2}}$$

Remarque :



(Q8) $K_a = 100$ rue/rad



$$K_a = \frac{K_c}{K_t}$$

(Q9) $C(p) = K_p\frac{1+T_i p}{T_i p}$ → Correcteur proportionnel intégral

(5)

Q10

$$FTBO(p) = \frac{500\,K_p}{0{,}1\,p} = \frac{5000\,K_p}{p}$$

$$FTBF(p) = \frac{5000\,K_p}{p + 5000\,K_p} = \frac{1}{1 + \frac{1}{5000\,K_p}\,p} = \frac{K}{1+\tau p}$$

$$t_{5\%} = 3\tau = \frac{3}{5000\,K_p} = 0{,}3 \implies K_p = \frac{1}{500} = 0{,}002$$

Rem : $K = 1$ donc précis.

Q11 Perturbation prise en compte $\Longleftrightarrow$ Retard pur

Frottements secs modélisés par un seuil.

Q32, 33, 35