PHYSIQUE APPLIQUEE (ELT)
FILIERE : ELECTROTECHNIQUE

1°) voir papier millimétré (3 pts)

2-1°) La valeur de I_e

$$\frac{E_V}{E_1} = \frac{N_V}{N_1} \Rightarrow E_V = E_1 \times \frac{N_V}{N_1}$$

I_a étant négligé donc $U = E_1 = 120V$

$$E_V = 120 \times \frac{1500}{1800} \Rightarrow E_V = 99{,}999V \simeq 100V$$

donc $E_V = 100V$ on a $\underline{I_e = 0{,}38A}$ (4 pts)

2-2°) La valeur de R_h

$$R_h + R_e = \frac{U}{I_e} \Rightarrow R_h = \frac{U}{I_e} - R_e \Rightarrow R_h = \frac{120}{0{,}38} - 100$$

$\underline{R_h = 215{,}789\,\Omega}$ (4 pts)

3°) La valeur de U_2

$$\frac{E_2}{E_V} = \frac{N_2}{N_V} \Rightarrow E_2 = E_V \times \frac{N_2}{N_V}$$

pour $I_e = 1{,}2\,A$ · $E_V = 144V$, $N_V = 1500\,tr/min$

$$E_2 = 144 \times \frac{1000}{1500} \qquad E_2 = 96V$$

d'où $U_2 = E_2 + R_a I_a \Rightarrow U_2 = 96 + 0{,}3 \times 20$

$\underline{U_2 = 102V}$ (4 pts)

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4-1 la valeur de E'

$U = E' + R_a I_a \Rightarrow E' = U - R_a I_a \Rightarrow E' = 120 - 0{,}3 \times 20$

$\underline{E' = 114\,V}$ (5 pts)

4-2 la vitesse N

calculons la valeur du courant d'excitation

$I_e = \frac{U}{R_h + R_e}$; $I_e = \frac{120}{100+50}$ $I_e = 0{,}8\,A$

$N = N_v \times \frac{E'}{E_v}$; $N = 1500 \times \frac{114}{131}$; $\underline{N = 1305{,}343\,tr/mn}$ (5 pts)

4-3 les pertes constantes P_c

$P_c = P_{em} = E I_{a_0}$ or $E = U_0 - R_a I_{a_0} \Rightarrow P_c = (U - R_a I_{a_0}) I_{a_0}$

$P_c = (120 - 0{,}3 \times 1{,}2) \times 1{,}2$ $\underline{P_c = 143{,}568\,W}$ (5 pts)

4-4) La puissance utile

$P_u = P_{em} - P_c$ or $P_{em} = E' I_a$ d'où $P_u = E' I_a - P_c$

$P_u = 114 \times 20 - 143{,}568$; $\underline{P_u = 2136{,}432\,W}$ (5 pts)

4-5) le rendement

$\eta = \frac{P_u}{P_{ab}} = \frac{P_u}{P_u + P_{Je} + P_{Ji} + P_c}$

$P_{Je} = \frac{U^2}{R_e + R_h}$; $P_{Je} = \frac{120^2}{50+100}$; $P_{Je} = 96\,W$

$P_{Ji} = R_a I_a^2$; $P_{Ji} = 0{,}3 \times 20^2$; $P_{Ji} = 120\,W$

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$$\eta = \frac{2136,432}{2136,432 + 96 + 120 + 143,568}$$

$\eta = 0,256$ soit $85,6\%$ (5pts)

5-1 La valeur de a

$$P_c = C_p \times \Omega \Rightarrow P_c = aN \times \frac{2\pi N}{60} \Rightarrow a = \frac{60 P_c}{2\pi N^2}$$

$$a = \frac{60 \times 143,568}{2\pi \times 1305,323^2} \Rightarrow a = 8,046.10^{-4}$$ (5 pts)

5-2) L'expression de C_u

$$C_u = C_{em} - C_p \quad ; \quad C_{em} = \frac{E I_a}{2\pi N} \quad \text{or } E = KN\phi$$

d'où $C_{em} = \frac{KN\phi}{2\pi N} \times I_a \Rightarrow C_{em} = \frac{K\phi}{2\pi} \times I_a$

$$E = U - R_a I_a \Rightarrow I_a = \frac{U - E}{R_a} \Rightarrow I_a = \frac{U - KN\phi}{R_a}$$

$$\Rightarrow C_{em} = \frac{K\phi}{2\pi} \times \frac{U - KN\phi}{R_a}$$

Pour $I_e = 0,8A \Rightarrow E = 131V$ et $N = 1500 tr/mn$

d'où $K\phi = \frac{131}{1500} \Rightarrow K\phi = 0,0873$

$$\cancel{C_{em} = \frac{0,0873}{2\pi} \times \frac{180}{}}$$

$$C_{em} = \frac{0,0873}{2\pi} \times \frac{(120 - 0,0873N)}{0,3}$$

$$C_{em} = 0,046(120 - 0,0873\,N)$$

$C_u = 0{,}046\left(120 - 0{,}0873\,\frac{N}{60}\right) - 8{,}046 \cdot 10^{-4} N$

$C_u = -8{,}715 \cdot 10^{-4} N + 5{,}52$ (5pts)

6-1°) La vitesse

$C_u = C_r \Rightarrow -8{,}7153 \cdot 10^{-4} N + 5{,}52 = 59 \cdot 10^{-3} N - 60{,}792$

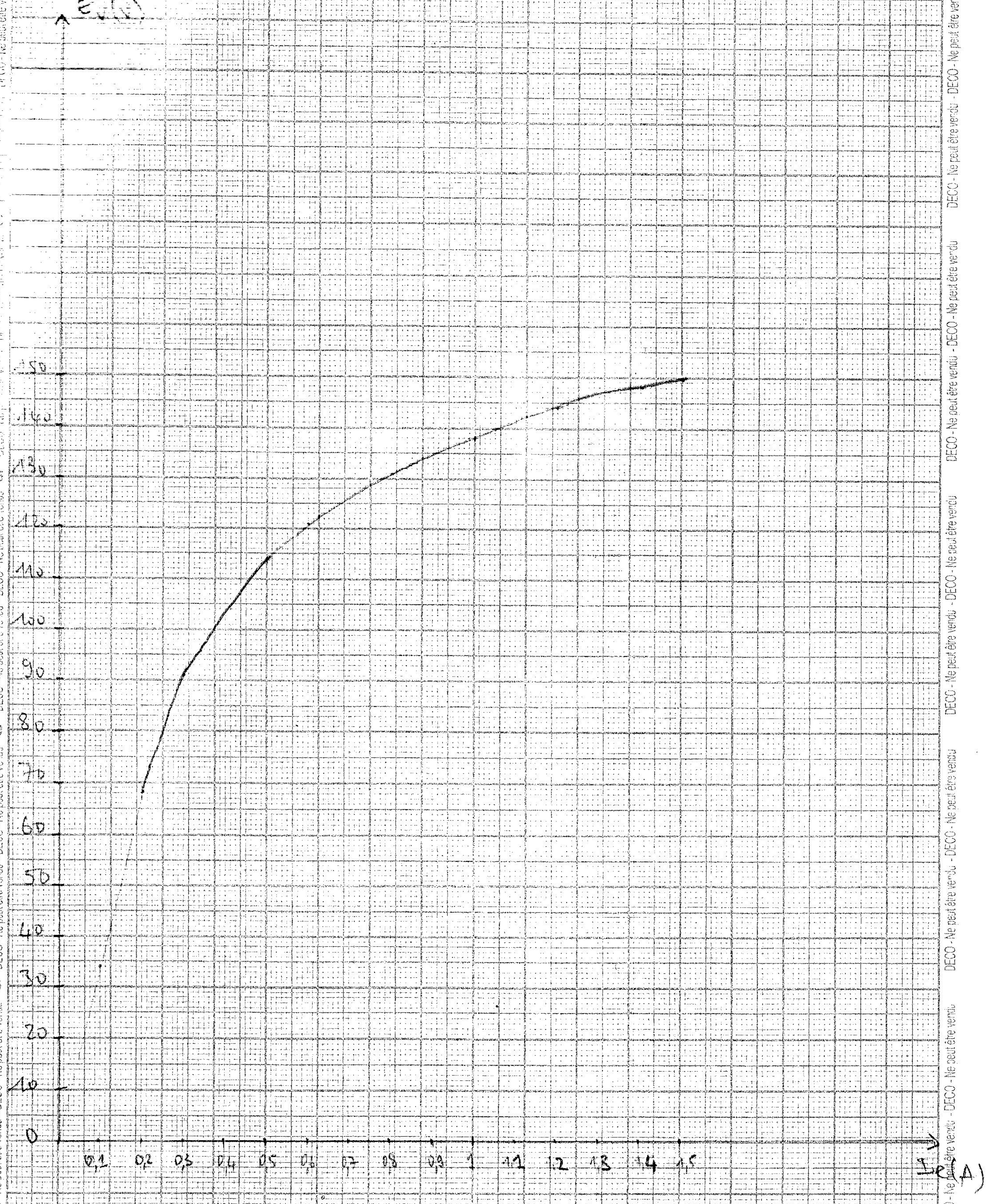
$N = \frac{60{,}792 + 5{,}52}{59 \cdot 10^{-3} + 8{,}7153 \cdot 10^{-4}}$

$N = 1107{,}571$ tr/min (5pts)

6-2°) Le couple utile

$C_u = -8{,}7153 \cdot 10^{-4} \times 1107{,}572 + 5{,}52$

$C_u = 4{,}554$ N.m (5pts)


Ev(V)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
1,1
1,2
1,3
1,4
1,5
Ie(A)

PHYSIQUE APPLIQUEE :

ELECTRONIQUE DE PUISSANCE DE ELT

1) tracer $U_{co}(\theta)$; V_{D_3} ; i_{D_1} et i_{res_2} 8pts
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2) calcule la valeur moyenne $U_c(\theta)$

$$\bar{U}_c = \frac{3\sqrt{3}\ V_{max}}{\pi} \qquad \bar{U}_c = \frac{3\sqrt{3} \times 230\sqrt{3}}{\pi}$$

2pts

$$\boxed{\bar{U}_c = 537{,}991\,V}$$

3)

31- Calcule la valeur efficace du fondamental pour $k = 1$

$$U_c(\theta) = \bar{U}_c\left(1 + \frac{2}{35}\cos 6\theta\right)$$

$$U_{c1} = \frac{2}{35} \times \bar{U}_c \times \frac{1}{\sqrt{2}} = \frac{2}{35} \times 537{,}99 \times \frac{1}{\sqrt{2}}$$

$$\boxed{U_{c1} = 21{,}738\,V}$$

1pts

32 - le taux d'ondulation

$$\tau = \frac{U_{c1}}{U_c} = \frac{21{,}738}{537{,}99} \qquad \boxed{\tau = 0{,}04}$$

$$Z = \sqrt{F^2 - 1} \Rightarrow F = \sqrt{1 + Z^2}$$

1pts

$$F = \sqrt{1 + 0{,}04^2} \quad \boxed{F = 1{,}0007 \simeq 1}$$

donc $\boxed{U_c = \overline{U_c} = 537{,}991\,V}$

1pts

4.1) la valeur moyenne et efficace dans une Diode

$$\overline{I_D} = \frac{\overline{I_c}}{3} = \frac{7{,}2}{3} \quad \boxed{\overline{I_D} = 2{,}4\,A}$$

2pts

$$I_D = \frac{I_c}{\sqrt{3}} = \frac{7{,}2}{\sqrt{3}} \quad \boxed{I_D = 4{,}157\,A}$$

2pts

4.2) La puissance apparente

$$S = 3\,V_{re} \cdot I_S$$

$$I_S = I\sqrt{\frac{2}{3}} \quad I_S = 7{,}2\sqrt{\frac{2}{3}}$$

$$I_S = 5{,}879\,A$$

$$S = 3 \times 230 \times 5{,}879$$

$$\boxed{S = 4056{,}51\,VA}$$

2pts

4.3 $\cos\varphi$

$$\cos\varphi = \frac{P}{S}$$

1pts

$$= \frac{7{,}2 \times 537{,}991}{4056{,}51}$$

$$\boxed{\cos\varphi = 0{,}955}$$

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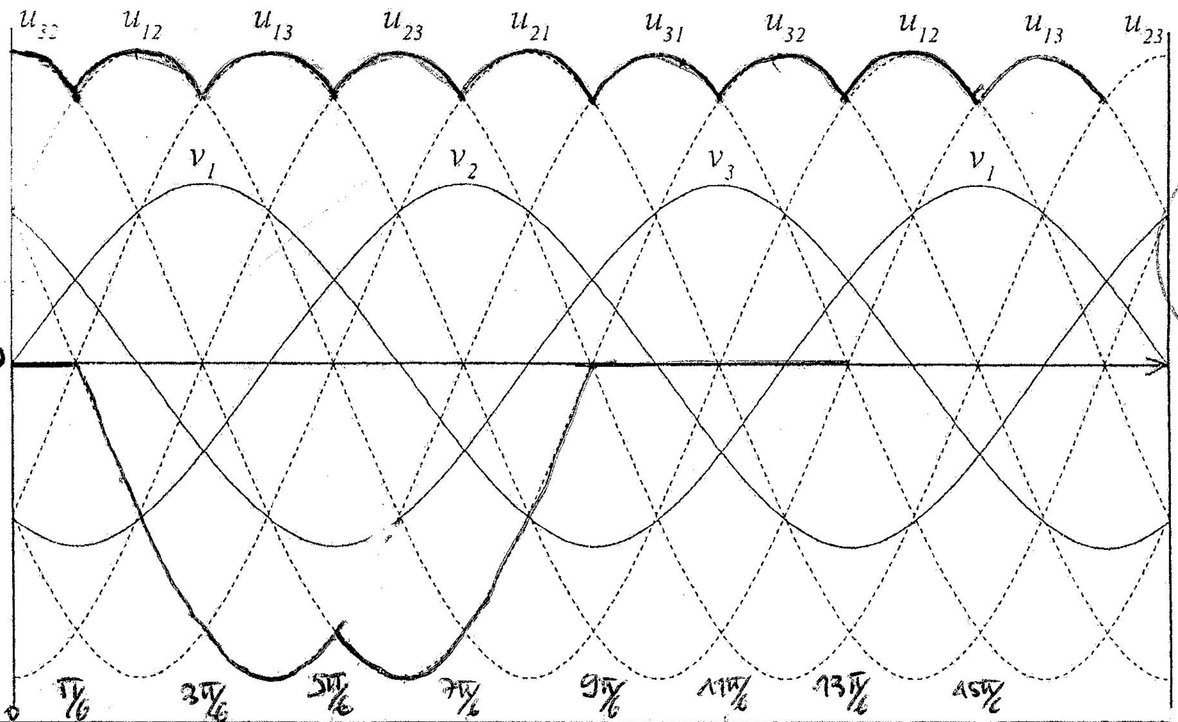
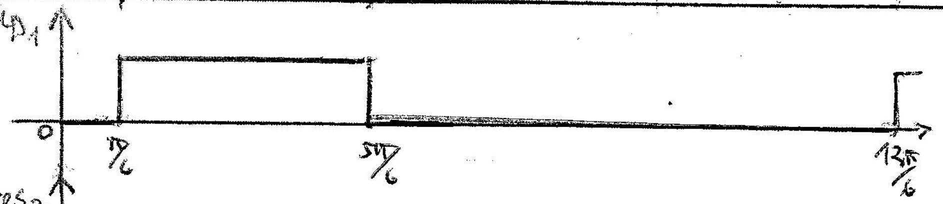
DOCUMENT RÉPONSE (À RENDRE)



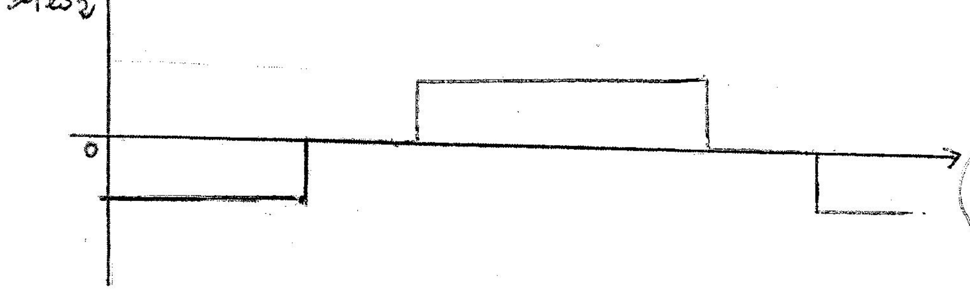
2 pts

D_1		1	1					1	
D_2				1	1				
D_3	1					1	1		
D_4					1	1			
D_5	1	1					1	1	
D_6			1	1					
$u_c(\theta)$	U_{32}	U_{12}	U_{13}	U_{23}	U_{21}	U_{31}	U_{32}	U_{12}	
v_{D3}	0	U_{31}	U_{31}	U_{32}	U_{32}	0	0	U_{31}	
i_{D1}	0	I	I	0	0	0	0	I	
i_{res2}	-I	-I	0	I	I	0	-I	-I	

4 pts



1 pts



1 pts

PHYSIQUE APPLIQUEE (ANALOGIQUE)
FILIERE : ELT

1-1 Valeur de ~~...~~ R_t

$t = 0°C \quad R_t = 100(1+0) \Rightarrow R_t = 100\,\Omega$

$t = 100°C \quad R_t = 100(1+100 \times 0{,}01) \Rightarrow R_t = 200\,\Omega$ 1 pt

1-2 l'expression de V_t

$V_t = R_t * I$ 2 pts

1-3 La valeur de V_t

$t = 0°C \quad V_t = 100 \times 1.10^{-3} \Rightarrow V_t = 0{,}1\,V$

$t = 100°C \quad V_t = 200 \times 1.10^{-3} \Rightarrow V_t = 0{,}2\,V$ 1 pt

2-1 Regime linéaire car on a une contre réaction (la sortie est reliée à l'entrée inverseuse) 2 pts

2-2 l'expression de V_2

$V^- = V_2 \times \frac{R_1}{R_1+R_2}$ or $V^+ = V^-$ d'où $V_t = V_2 \frac{R_1}{R_1+R_2}$

$V_2 = V_t\left(1 + \frac{R_2}{R_1}\right)$ 2pts

2-3 Valeur de A

$A = \frac{V_2}{V_t} \Rightarrow A = \frac{R_1 + R_2}{R_1}$. $A = \frac{1+49}{1}$

$A = 50$ 2pts

2-4 calcul de V_2

$V_2 = A \times V_t$

$t = 0°C$ $V_2 = 50 \times 0{,}1$ $V_2 = 5V$

$t = 100°C$ $V_2 = 50 \times 0{,}2$ $V_2 = 10V$ 1 pt

3-1 L'expression de Vref

$$V_{ref} = V_{cc} \times \frac{R_4 + aP_1}{R_4 + P_1 + R_3}$$ 2pts

3-2 valeur max et min de Vref

$a = 0$ $V_{ref\,min} = \frac{V_{cc} \times R_4}{R_4 + P_1 + R_3}$ $V_{ref\,mini} = \frac{10 \times 56}{56 + 10 + 36}$

$V_{ref\,min} = 5{,}49V$ 1pt

$a = 1$ $V_{ref\,max} = V_{cc} \times \frac{R_4 + P_1}{R_4 + P_1 + R_3}$ $V_{ref\,max} = 10 \times \frac{10 + 56}{56 + 10 + 36}$

$V_{ref\,max} = 6{,}47V$ 1 pt

4-1 C'est un comparateur 1pt

4-2 T mesurée > T consigne $V_s = 0V$

T mesurée < T consigne $V_s = 10V$ 2pts

4-3 Pour $V_s = 10V$ 1 pt

4-4. Température à régler

$V_{reg} = V_2$ pour T consigne

$$V_{cc} \times \frac{R_4 \times a P_1}{R_4 + P_1 + R_3} = A V_t$$

$$A \times R_t \times I = V_{reg}$$

$$A \times R_0 \times (1 + \alpha T) \times I = V_{reg}$$

$$T = \frac{V_{reg}}{\alpha A R_0 I} - \frac{1}{\alpha}$$

$$T_{min} = \frac{V_{reg\,min}}{\alpha A R_0 I} - \frac{1}{\alpha}$$

$$T_{min} = \frac{5{,}49}{0{,}01 \times 50 \times 100 \times 0{,}001} - \frac{1}{0{,}01}$$

$$T_{min} = 9{,}8\,°C$$

$$T_{max} = \frac{V_{reg\,max}}{\alpha A R_0 I} - \frac{1}{\alpha}$$

$$T_{max} = \frac{6{,}47}{0{,}01 \times 50 \times 100 \times 0{,}001} - \frac{1}{0{,}01}$$

$$T_{max} = 29{,}4\,°C$$

Il est possible de régler $9{,}8\,°C < T < 29{,}4\,°C$ 2pts

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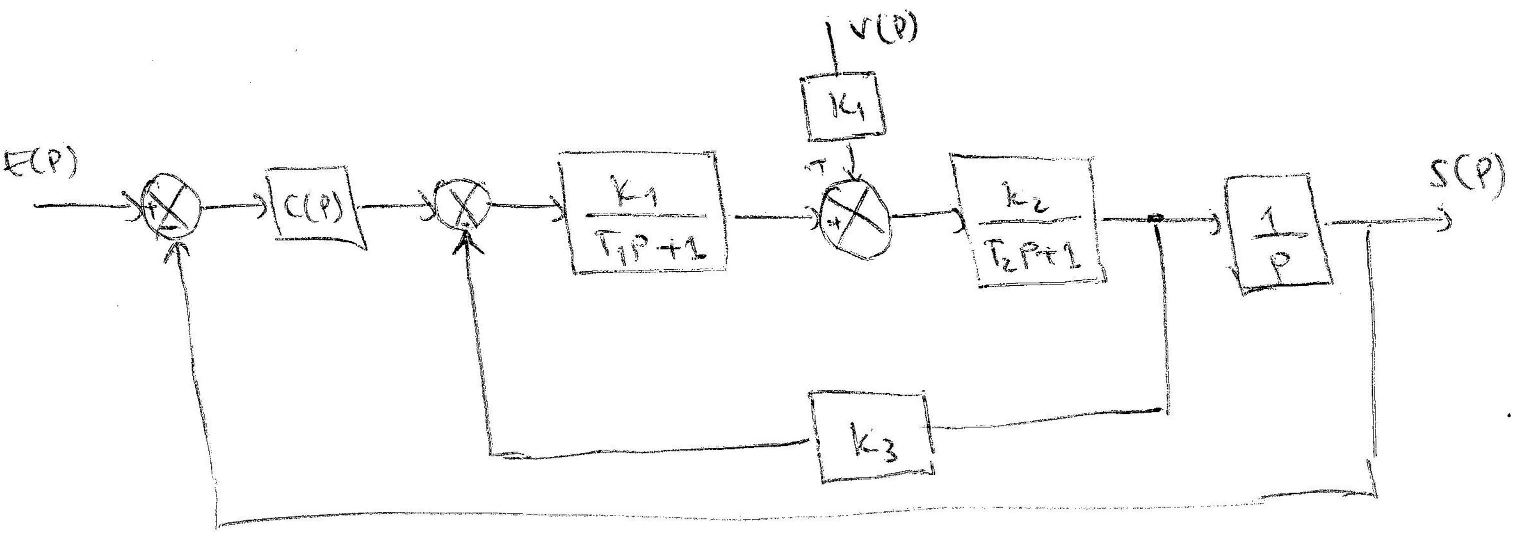
PHYSIQUE APPLIQUEE (AUTOMATIQUE)
FILIERE : ELT BTS 2017

1°) le signal s(t) est un angle (position) (2 pts)

2-1°) Expression de $F_1(p) = \frac{S(p)}{E(p)}$ si $v(t) = 0$



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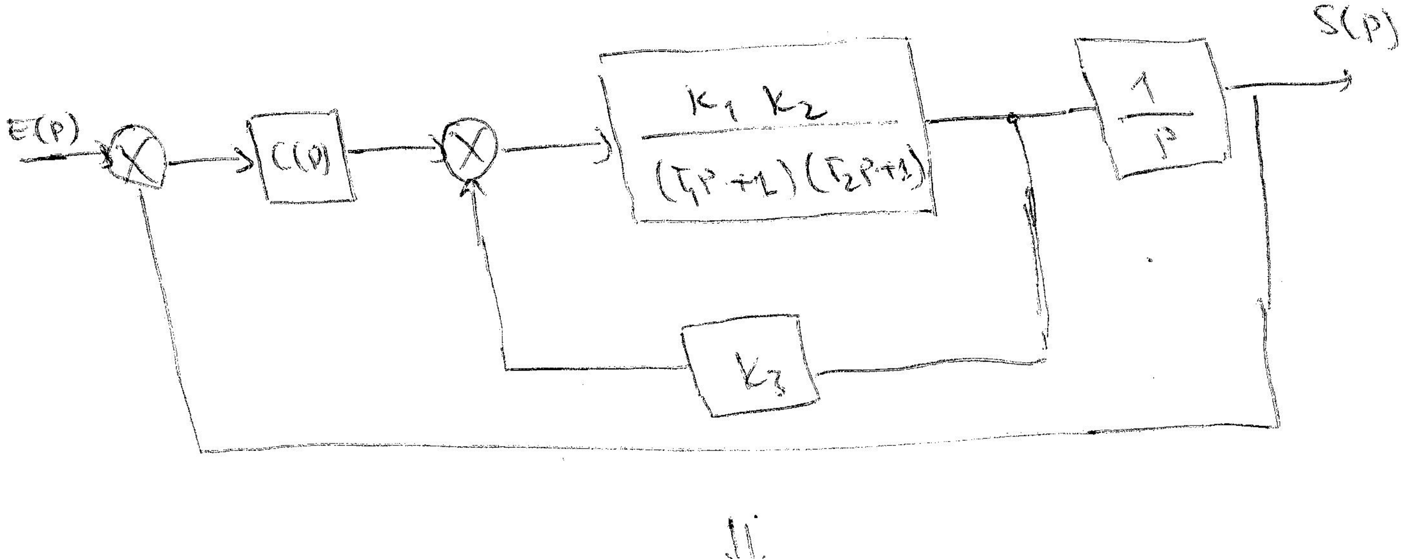

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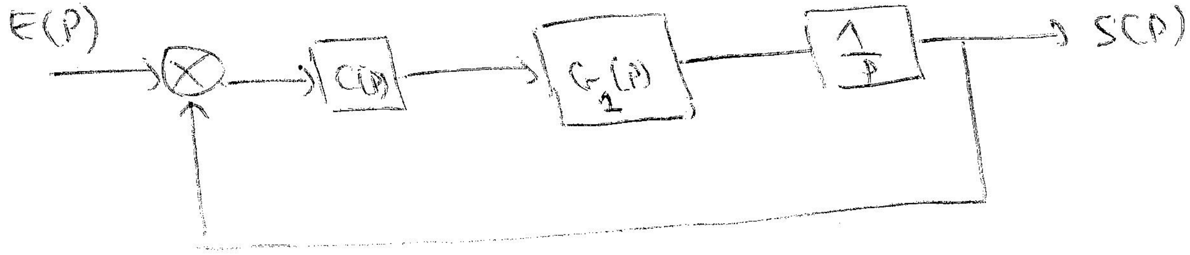


$$G_1(P) = \frac{\dfrac{K_1 K_2}{(T_1 P+1)(T_2 P+1)}}{1+\dfrac{K_1 K_2 K_3}{(T_1 P+1)(T_2 P+1)}}$$

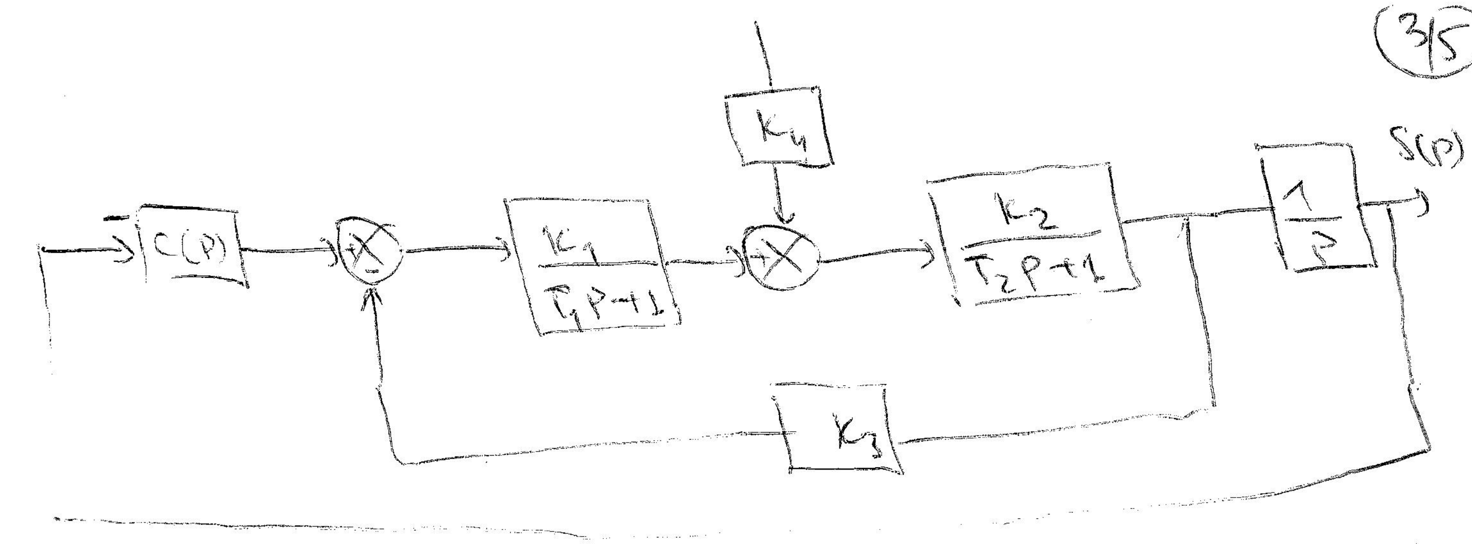
$$G_1(P) = \frac{K_1 K_2}{(T_1 P+1)(T_2 P+1)+K_1 K_2 K_3}$$

$$F_1(P) = \frac{C(P) \times G_1(P) \times \frac{1}{P}}{1+C(P) \times G_1(P) \times \frac{1}{P}}$$

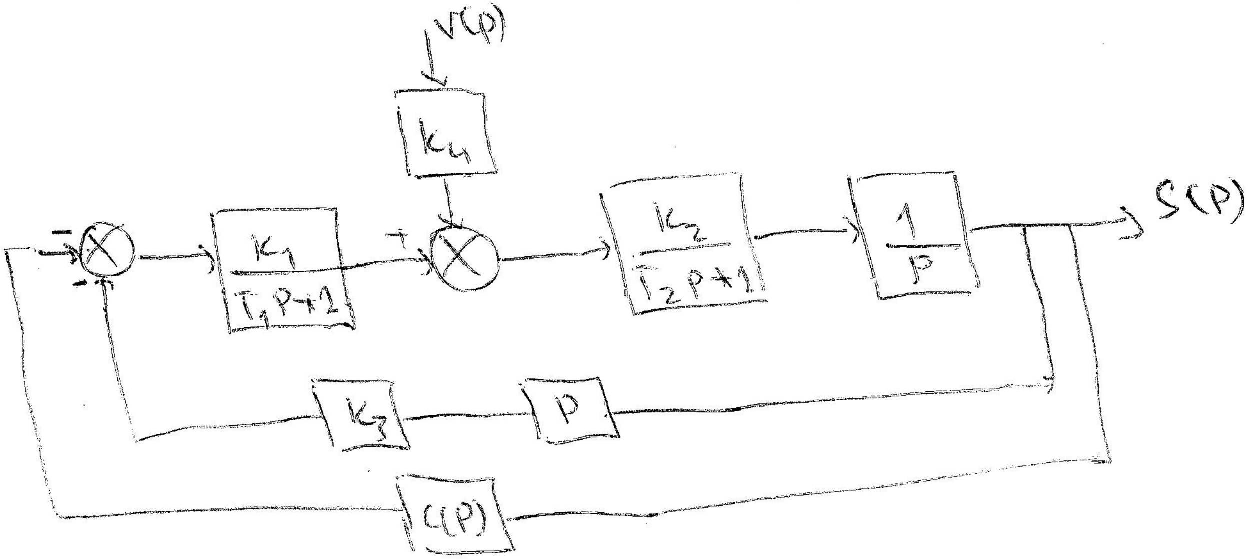
$$F_1(P) = \frac{\dfrac{C(P) \times K_1 K_2}{P\left[(T_1 P+1)(T_2 P+1)+K_1 K_2 K_3\right]}}{1+\dfrac{C(P) \times K_1 K_2}{P\left[(T_1 P+1)(T_2 P+1)+K_1 K_2 K_3\right]}}$$

$$\boxed{F_1(P) = \frac{C(P) \times K_1 K_2}{C(P) \times K_1 K_2 + P\left[(T_1 P+1)(T_2 P+1)+K_1 K_2 K_3\right]}}$$ 4 pts

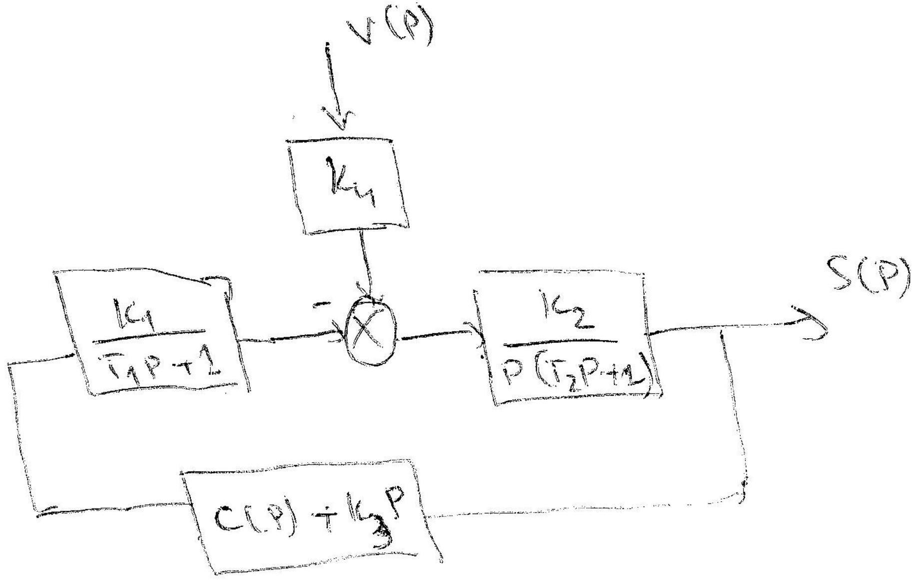
2-2 expression de $F_2(P) = \dfrac{S(P)}{V(P)}$ si $e(t)=0$



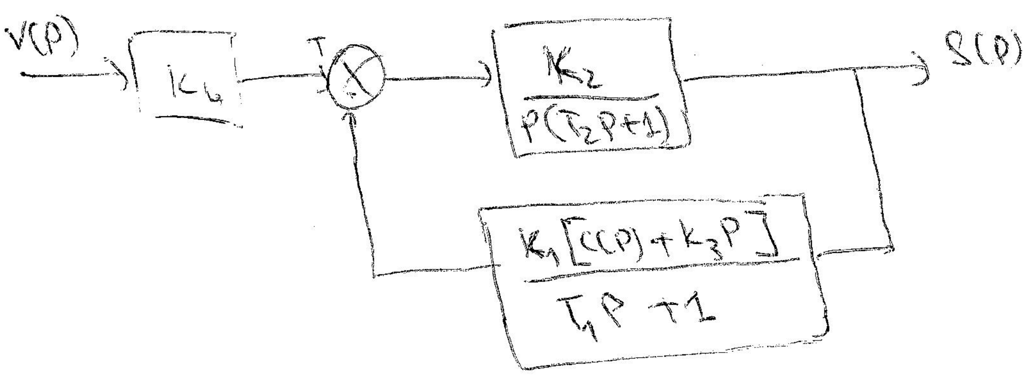
C(p)
K_4
$\frac{K_1}{T_1 p + 1}$
$\frac{K_2}{T_2 p + 1}$
$\frac{1}{p}$
S(p)
K_3



V(p)
K_4
$\frac{K_1}{T_1 p + 1}$
$\frac{K_2}{T_2 p + 1}$
$\frac{1}{p}$
S(p)
K_3
p
C(p)



V(p)
K_4
$\frac{K_1}{T_1 p + 1}$
$\frac{K_2}{p(T_2 p + 1)}$
S(p)
$C(p) + K_3 p$



$$F_2(p) = \frac{\dfrac{K_2K_4}{p(T_2p+1)}}{1 + \dfrac{K_2}{p(T_2p+1)} \times \dfrac{K_1[C(p)+K_3p]}{T_1p+1}}$$

$$F_2(p) = \frac{\dfrac{K_2K_4}{p(T_2p+1)}}{1 + \dfrac{K_1K_2[C(p)+K_3p]}{p(T_2p+1)(T_1p+1)}}$$

donc $$\boxed{F_2(p) = \frac{K_2K_4(T_1p+1)}{C(p)\times K_1K_2 + p\left[(T_1p+1)(T_2p+1)+K_1K_2K_3\right]}}$$ (4 pts)

3°) la relation entre S(p), E(p) et V(p)

$$S(p) = E(p)\times F_1(p) + V(p)\,F_2(p)$$

d'où $$\boxed{S(p) = \frac{E(p)\,C(p)\times K_1K_2 + V(p)\,K_2K_4(T_1p+1)}{C(p)K_1K_2 + p\left[(T_1p+1)(T_2p+1)+K_1K_2K_3\right]}}$$ (2 pts)

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4°) valeur finale de $s(t)$ si $e(t) = 0$ Cas idéal

$$s(\infty) = \lim_{p \to 0} p S(p) = \frac{K_4 V(p)}{K_1 \cdot C(p)}$$

Dans le cas idéal $V(p) = 0$ donc $\boxed{s(\infty) = 0}$ 2pts

5-1°) la valeur finale de $s(t)$ quand $e(t) = 0$ et $v(t) = a\,\delta(t)$

$$s(\infty) \lim_{p \to 0} p S(p) = \frac{K_4 V(p)}{K_1 \cdot C(p)} \qquad V(p) = a$$

donc $\boxed{s(\infty) = \frac{a K_4}{K_1 \cdot C(p)}}$ 2pts

5-2°) la valeur finale de $s(t)$ quand $e(t) = 0$ et $v(t) = a\,u(t)$

$$s(\infty) = \lim_{p \to 0} p S(p) = \frac{K_4 V(p)}{K_1 \cdot C(p)} \qquad V(p) = \frac{a}{p}$$

donc $\boxed{s(\infty) = \infty}$ 2pts

6°) le système n'élimine pas la pertubation 2pts