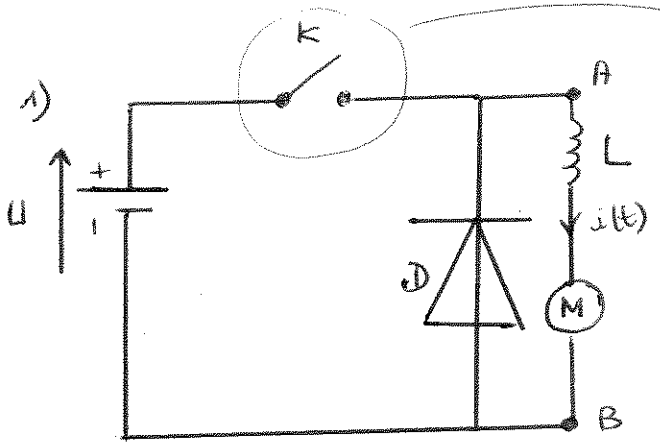
Fiche exercices 17 — HACHEURS

Exercice 1

partie 1

1)



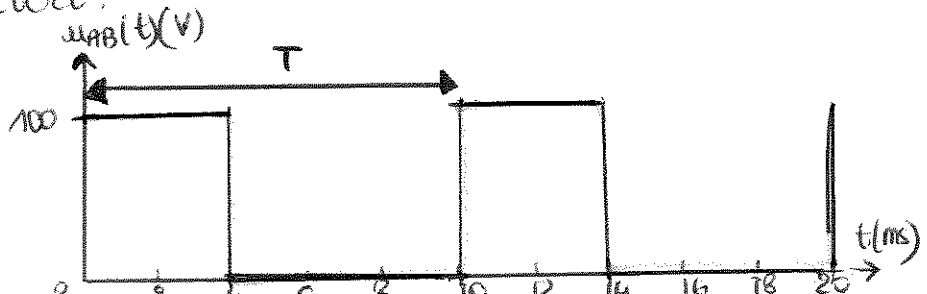
2) interrupteur K peut être un transistor

3) α = rapport cyclique

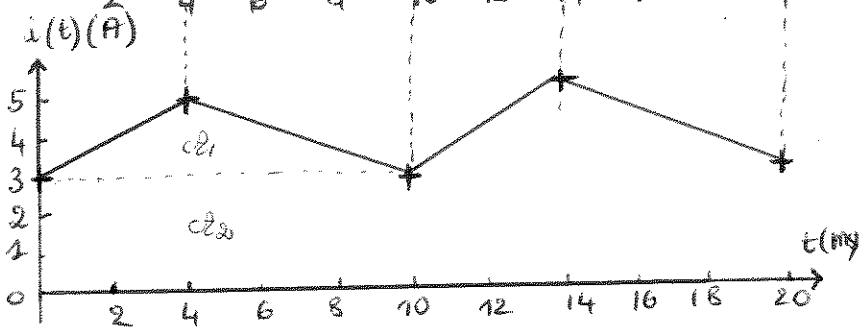
$$\alpha = \frac{t_{on}}{T} \text{ en \%}$$

4) permet continuité du courant dans la charge même si K ouvert.

5) T = 20ms
α = 0,4 %
U = 100 V



6)



7) $\langle u_{AB}(t) \rangle = \frac{\mathcal{A}_1}{T} = \frac{U \times \alpha T}{T} = U\alpha$

$\langle u_{AB}(t) \rangle = 0,4 \times 100 = 40\ V$

8) $\langle i(t) \rangle = \frac{I_{max} + I_{min}}{2} = \frac{5+3}{2} = 4A$

ou $\langle i(t) \rangle = \frac{\mathcal{A}_1 + \mathcal{A}_2}{T} = \frac{10 \times 2 \div 2 + 10 \times 3}{10} = 4A$

partie 2

U = 100V
α = 0,8 f.e.m = 75V
n = 850 tr min^{-1}

9) a) $\langle u_{AB}(t) \rangle = U \times \alpha = 100 \times 0,8 = 80V$

b) on sait que :

$\langle u_{AB}(t) \rangle = \langle u_R \rangle + \underbrace{\langle u_L \rangle}_{\left\langle L \times \frac{di(t)}{dt} \right\rangle = 0}$

$\langle u_R \rangle = 80V$

c) $f.e.m = E = U_n - r \times I$

$\langle E \rangle = \langle U_n \rangle - \langle r \times I \rangle$

$\langle I \rangle = \dfrac{\langle U_n \rangle - \langle E \rangle}{r} = \dfrac{80 - 75}{2,4} = 2,1\ A$

d) $\left.\begin{array}{l} Tem = k \times \phi \times I \\ E = k \times \phi \times \Omega \end{array}\right\} \quad \dfrac{Tem}{E} = \dfrac{I}{\Omega} \Rightarrow \quad Tem = \dfrac{E \times I}{\Omega} = \dfrac{P}{\Omega}$

$Tem = \dfrac{75 \times 2,1}{\frac{850 \times 2\pi}{60}} = 1,77\ N.m$

10) $\alpha = 0,4$
$Tem = 1,77\ N.m$
$I = 2,1\ A$
$r = 2,4\ A$
$U = 100\ V$

$\Omega = \dfrac{E \times I}{Tem} = \dfrac{(U_n - rI) \times I}{Tem} = \dfrac{(U_{AB} - rI) \times I}{Tem}$

$= \dfrac{(U \times \alpha - rI) \times I}{Tem} = \dfrac{(100 \times 0,4 - 2,4 \times 2,1) \times 2,1}{1,77}$

$\Omega = 41,5\ rad.s^{-1}$ $\quad \times \frac{60}{2\pi}$

$n = 396\ tr.min^{-1}$

11) si $\alpha = 0,4$ alors $n = 396\ tr.min^{-1}$ $\quad \Omega = 41,5\ rad.s^{-1}$
si $\alpha = 0,8$ alors $n = 850\ tr.min^{-1}$ $\quad \Omega = 89\ rad.s^{-1}$

commander $\qquad$ rapport cyclique

Exercice 2

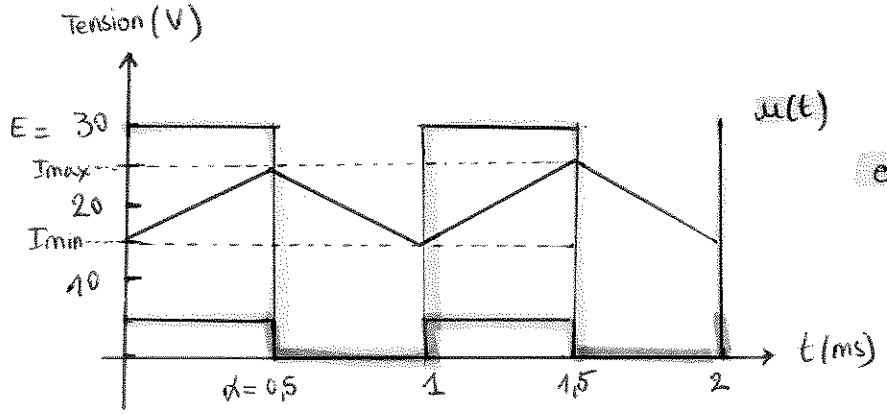
$E = 30\,V$

$E' = f.e.m = 0{,}20 \times n$ (n en $tr.min^{-1}$)

1) fréquence : $f = \frac{1}{T} = \frac{1}{1 \times 10^{-3}} = 10^3\,Hz$

rapport cyclique : $\alpha = 0{,}5$

2)



commande du hacheur

3) $\langle u(t) \rangle = E \times \alpha$

4) $I_{min} = 1{,}5\,A$

5) $I_{max} = 2{,}0\,A$

$\langle I(t) \rangle = \frac{I_{min} + I_{max}}{2} = \frac{2 + 1{,}5}{2} = \frac{3{,}5}{2} = 1{,}75\,A$

6) $I = 1{,}75\,A$; $u_L = 0\,V$; $R = 2{,}0\,\Omega$

Loi des mailles : $\langle u(t) \rangle = E' + R \times I + \underbrace{u_L}_{=0}$

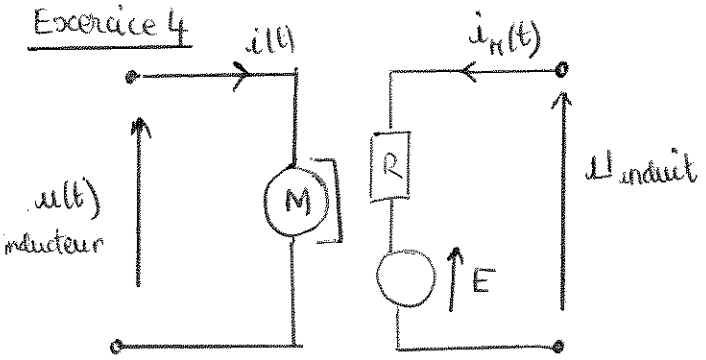
$E' = E\alpha - R \times I$

$= 30 \times 0{,}5 - 2 \times 1{,}75$

$= 11{,}5\,V$

$n = \frac{E'}{0{,}20} = \frac{11{,}5}{0{,}20} = 57{,}5\,tr.min^{-1}$

Exercice 4



$R = 0{,}1\ \Omega$

$E = k\Phi\Omega$

k : 2 V rad^{-1} s

$\langle I \rangle = 10\ A$

Batterie $U = 12V$

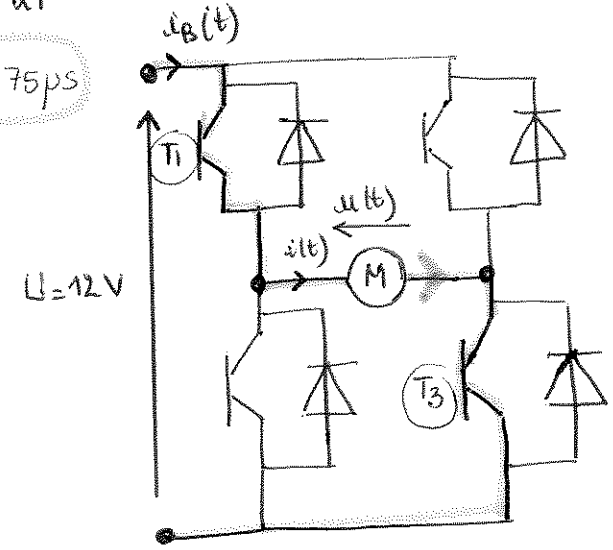
stratégie 1

1) si $u(t) = 12V$ | $I = 10A$ | $0 < t < \alpha T$

$0 < t < 75\mu s$

composants commandés | K_1 K_3

composants passants | T_1 T_3



$u(t) = 12V$, $i(t) > 0$ $\Rightarrow$ $p(t) > 0$

moteur reçoit de l'énergie

Batterie $\longrightarrow$ | charge moteur

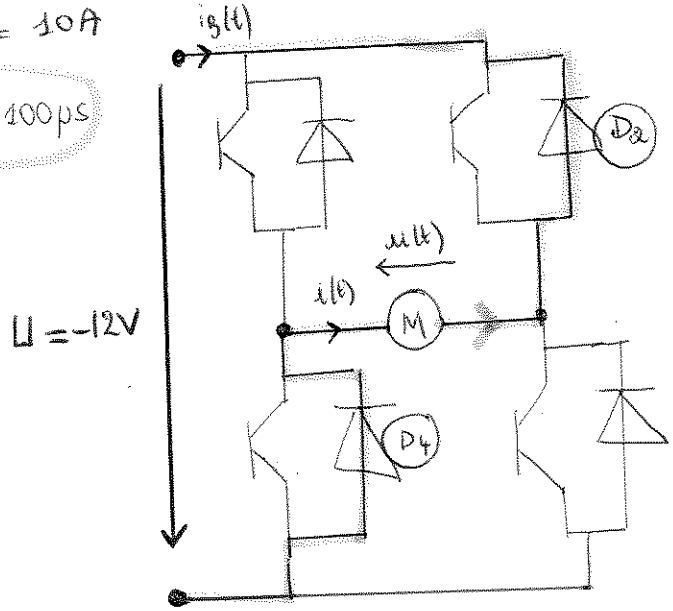
$i_B(t) = +10A$

2) si $u(t) = -12V$ | $\alpha T < t < T$ | $I = 10A$

$75\mu s < t < 100\mu s$

composants commandés | K_2 K_4

composants passants | D_2 D_4



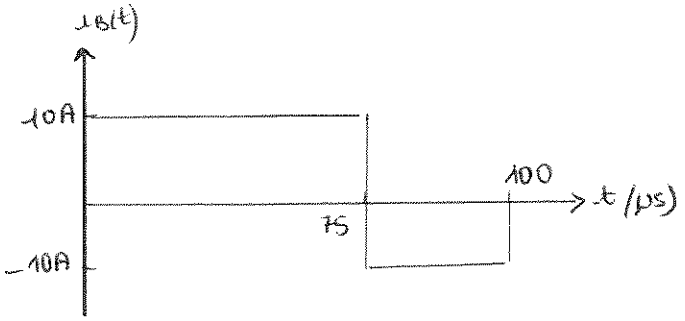
$u(t) = -12V$, $i(t) > 0$ $\Rightarrow$ $p(t) < 0$

moteur libère de l'énergie

moteur | charge $\longrightarrow$ batterie

$i_B(t) = -10A$

3) courant :



4) tension : $\langle u_B(t) \rangle = \frac{12 \times 75 - 12 \times 25}{100} = 6V$

5) vitesse rotation : $E = k_b \cdot \phi \cdot \Omega$ donc $\Omega = \frac{E}{k_b \cdot \phi}$

$E = U - R \times I$ $\Omega = \frac{U - RI}{k_b \phi} = \frac{6 - 0,1 \times 10}{2}$

$\Omega = 2,5 rad.s^{-1}$

$\Omega > 0$ le store se déploie

6) moment du couple : $T_{em} = k_b \cdot \phi \cdot I$

$= 2 \times 10$

$= 20 N.m$

puissance mécanique : $P_{em} = T_{em} \times \Omega$

$= 20 \times 2,5$

$= 50 W$

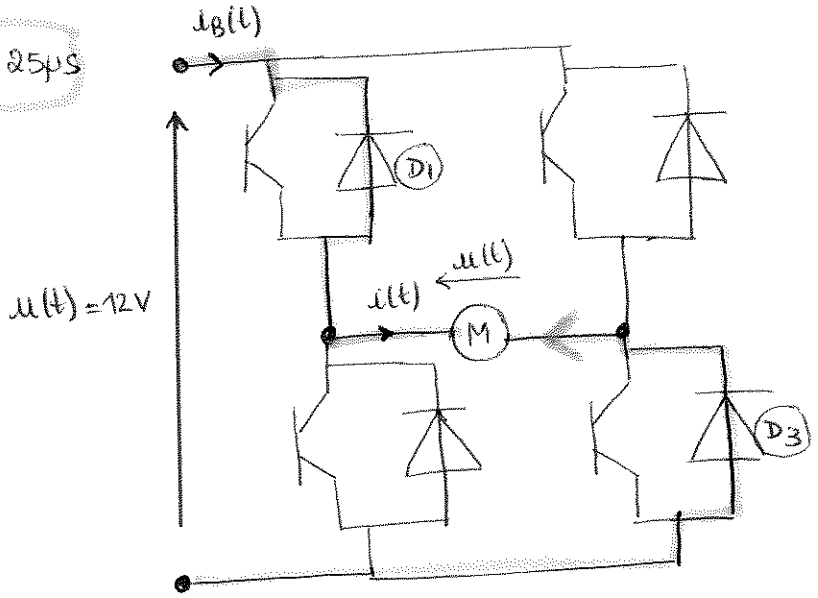
stratégie 2

7) si $u(t) = 12V$ | composants commandés | K_1 et K_3 | composants passants | D_1 D_3

$0 < t < \alpha T$

$I = -10A$

$0 < t < 25\mu s$



$u(t) = 12V$, $i(t) < 0$ } $p(t) < 0$

moteur libère de l'énergie

moteur charge → batterie

$i_B(t) = -i(t) = +10A$

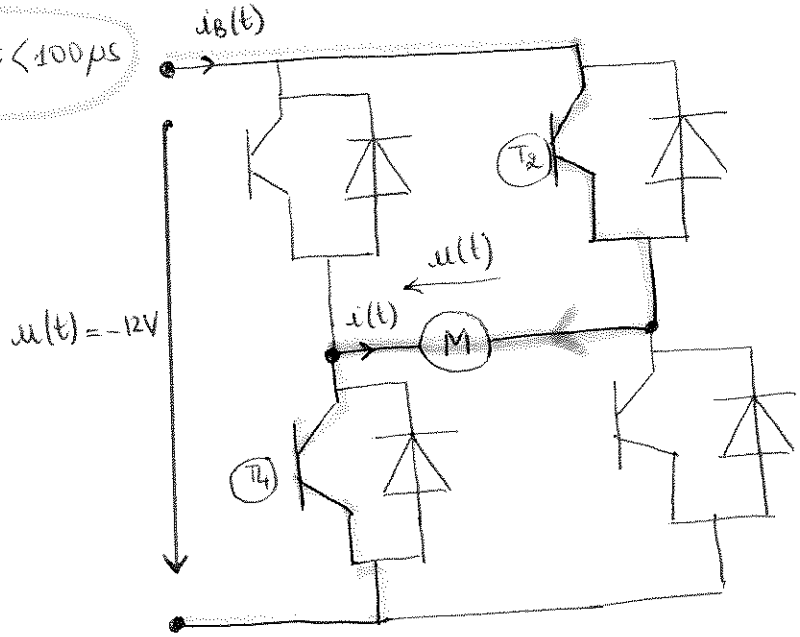
si $u(t) = -12V$

$\alpha T < t < T$

$I = -10A$

composants commandés | composants passants

$25\mu s < t < 100\mu s$



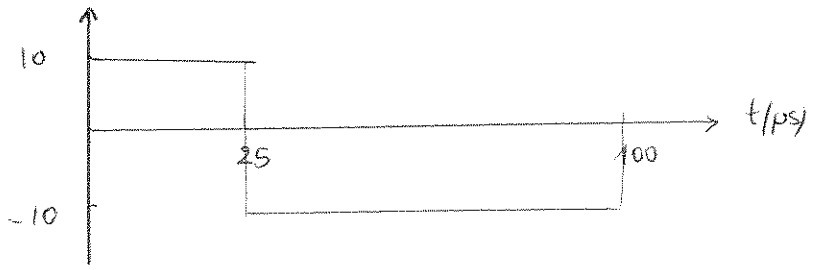
$u(t) = -12V$, $i(t) < 0$ } $p(t) > 0$

moteur reçoit de l'énergie

batterie → moteur charge

$i_B(t) = i(t) = -10A$

- courant $i_B(t)$



tension $\langle u(t) \rangle = \dfrac{12 \times 25 - 12 \times 75}{100} = -6\,V$

vitesse rotation $\Omega = \dfrac{E}{k\phi} = \dfrac{U - R \times I}{k\phi} = \dfrac{-6 - 0,1 \times (-10)}{2}$

$\Omega = -2,5\ rad.s^{-1}$ $\Omega < 0$ store se rétracte

moment du couple $T_{em} = k\phi I$

$= 2 \times (-10)$

$= -20\ N.m$

puissance mécanique $P_{em} = T_{em} \times \Omega$

$= -20 \times -2,5$

$= 50\,W$