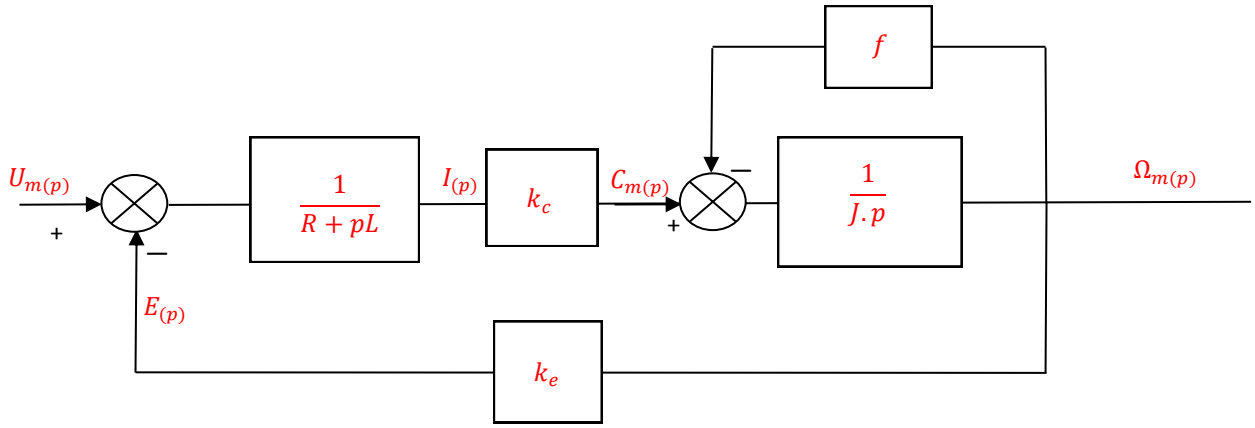
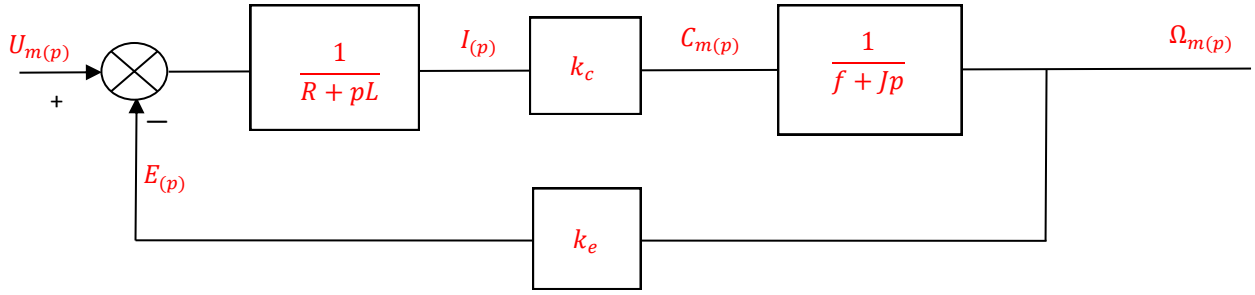
CORRIGE NAO_A1_DR1

Q1



Q2



$$\Omega_{m(p)} = \frac{1}{Jp}.\left(C_{m(p)} - f.\Omega_{m(p)}\right) = \frac{C_{m(p)}}{Jp} - \frac{f}{Jp}.\Omega_{m(p)}$$

$$\Omega_{m(p)}.\left(1 + \frac{f}{Jp}\right) = \frac{C_{m(p)}}{Jp}$$

$$\Omega_{m(p)}.(Jp + f) = C_{m(p)}$$

$$\frac{\Omega_{m(p)}}{C_{m(p)}} = \frac{1}{(Jp+f)}$$

Q3

$$\Omega_{m(p)} = \frac{1}{Jp+f}.C_{m(p)} = \frac{1}{Jp+f}.k_c.\frac{1}{R+pL}.\left(U_{m(p)} - E_{(p)}\right) = \frac{k_c}{(Jp+f).(R+pL)}.\left(U_{m(p)} - k_e.\Omega_{m(p)}\right)$$

$$\Omega_{m(p)}.\left(1 + \frac{k_c.k_e}{(Jp+f).(R+pL)}\right) = \frac{k_c}{(Jp+f).(R+pL)}.U_{m(p)}$$

$$\Omega_{m(p)}.\left((Jp+f).(R+pL) + k_c.k_e\right) = k_c.U_{m(p)}$$

$$H_{m(p)} = \frac{\Omega_{m(p)}}{U_{m(p)}} = \frac{k_c}{(Jp+f).(R+pL) + k_c.k_e}$$

$$H_{m(p)} = \frac{k_c}{Rf + RJp + Lfp + Ljp^2 + k_c.k_e} = \frac{k_c}{(Rf + k_c.k_e) + (RJ + Lf)p + LJp^2}$$

$$H_{m(p)} = \frac{\frac{k_c}{Rf + k_c.k_e}}{1 + \frac{RJ + Lf}{Rf + k_c.k_e}p + \frac{LJ}{Rf + k_c.k_e}p^2}$$

Q4

$$\tau_m.\tau_e = \frac{R.J}{k_e.k_t + R.f}.\frac{L}{R} = \frac{LJ}{Rf + k_c.k_e}$$

$$\frac{RJ + Lf}{Rf + k_c.k_e} = \frac{RJ}{Rf + k_c.k_e} + \frac{Lf}{Rf + k_c.k_e} = \tau_m + \alpha.\tau_e$$

avec $\alpha = \frac{Rf}{Rf + k_c.k_e}$

Q5

$k_e = 2{,}1V$ pour 1000 rpm

$k_e = \frac{2{,}1\ 60}{1000.2.\pi} = 20{,}05.10^{-3}\ V.s/rad$

$k_c = 20{,}1\ mNm/A$

$k_c = 20{,}1.10^{-3}\ Nm/A$

$k_c = k_e$ à 0,25 % près

Q6

$J = J_{rotor} + \frac{J_{main}}{r^2} = 0{,}76.10^{-7} + \frac{7{,}055.10^{-5}}{50{,}61^2} = 1{,}035\ 10^{-7}\ kg.m^2$

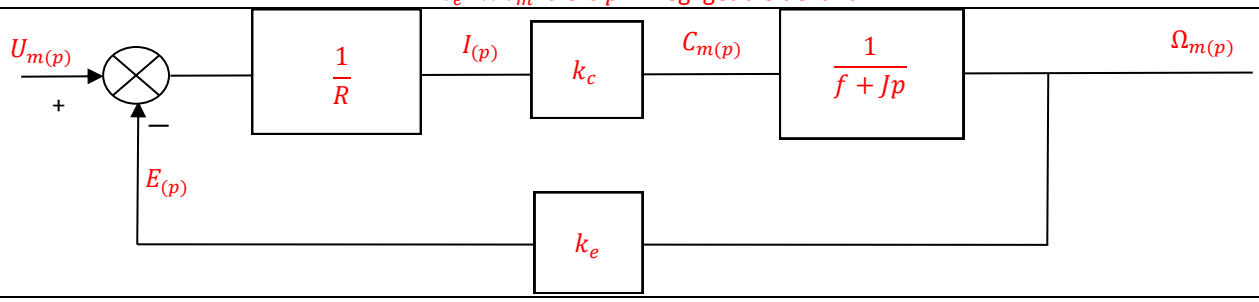
$J = 1{,}035\ 10^{-7}\ kg.m^2$

Q7

$$\tau_m = \frac{R.J}{k_e.k_t+R.f} = \frac{38{,}4.1{,}035\ 10^{-7}}{20{,}1^2.10^{-6}+38{,}4.6.10^{-6}} = 6{,}26\ ms \qquad \tau_e = \frac{L}{R} = \frac{0{,}9.10^{-3}}{38{,}4} = 0{,}023\ ms$$

$\tau_e \ll \tau_m$ alors $p.L$ négligeable devant R

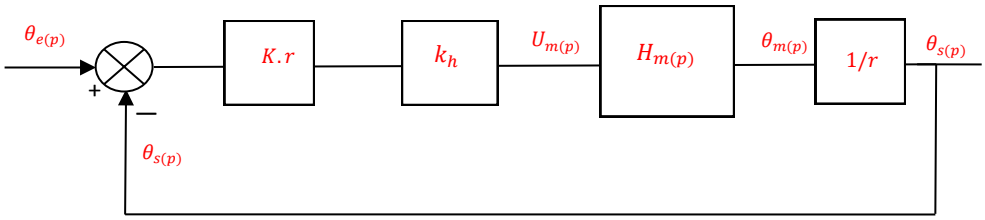
Q8



Q9

$$H_{m(p)} = \frac{\frac{k_c}{Rf+k_c.k_e}}{1+\frac{RJ+Lf}{Rf+k_c.k_e}p+\frac{LJ}{Rf+k_c.k_e}p^2} = \frac{\frac{k}{Rf+k^2}}{1+\tau_m p} = \frac{H_{mo}}{1+\tau_m p}$$

Q10



Q11

$$\theta_{s(p)} = \frac{1}{r}.H_{m(p)}.k_h.K.r.(\theta_{e(p)} - \theta_{s(p)}) = H_{m(p)}.k_h.K.\theta_{e(p)} - H_{m(p)}.k_h.K.\theta_{s(p)}$$

$$\theta_{s(p)}.(1 + H_{m(p)}.k_h.K) = H_{m(p)}.k_h.K.\theta_{e(p)}$$

$$\theta_{s(p)}.(1 + H_{m(p)}.k_h.K) = H_{m(p)}.k_h.K.\theta_{e(p)}$$

$$H_{BF(p)} = \frac{\frac{H_{mo}}{1+\tau_m p}.k_h.K}{1+\frac{H_{mo}}{1+\tau_m p}.k_h.K} = \frac{H_{mo}.k_h.K}{(1+\tau_m p)+H_{mo}.k_h.K} = \frac{H_{mo}.k_h.K}{(1+H_{mo}.k_h.K)+\tau_m p} = \frac{\frac{H_{mo}.k_h.K}{1+H_{mo}.k_h.K}}{1+\frac{\tau_m}{1+H_{mo}.k_h.K}.p}$$

$$H_{BF(p)} = \frac{H_{BFo}}{1+\frac{\tau_m}{1+H_{mo}.k_h.K}.p} \quad \text{avec} \quad H_{BFo} = \frac{H_{mo}.k_h.K}{1+H_{mo}.k_h.K}$$

Q12

$$H_{BF(p)} = \frac{\frac{H_{mo}.k_h.K}{1+H_{mo}.k_h.K}}{1+\frac{\tau_m}{1+H_{mo}.k_h.K}.p} \quad \text{avec } H_{mo} = \frac{k}{Rf+k^2} = \frac{20{,}1.10^{-3}}{38{,}4.6.10^{-6}+(20{,}1.10^{-3})^2} = 31{,}68\ rad/Vs$$

$$H_{BF(p)} = \frac{\frac{31{,}68\ .\ 10{,}31.\ 10}{1\ +\ 31{,}68\ .\ 10{,}31.\ 10}}{1\ +\ \frac{6{,}26.\ 10^{-3}}{1\ +\ 31{,}68\ .\ 10{,}31.\ 10}.\ p} = \frac{1}{1\ +\ 1{,}9.\ 10^{-6}p}$$