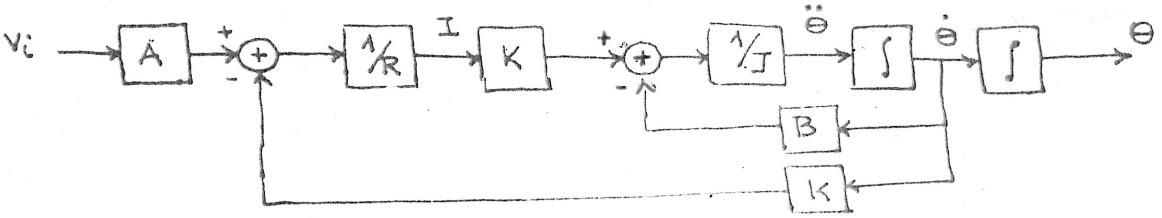
PROBLEMA 1 (Período especial: 03/04/2018)

a) $L \sim 0 \Rightarrow I = \dfrac{AV_i - K\dot{\theta}}{R}$

$$\boxed{J\ddot{\theta} + B\dot{\theta} = K\left(\frac{AV_i - K\dot{\theta}}{R}\right)}$$

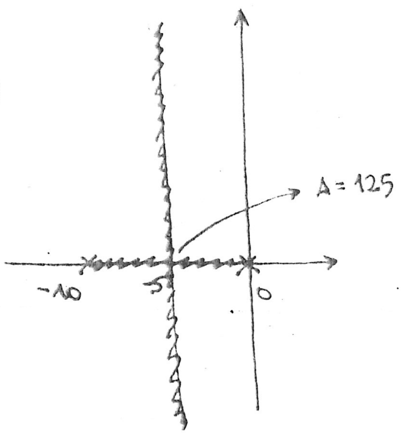


$$\boxed{G(s) = \frac{\theta(s)}{V_i(s)} = \frac{KA/R}{s\left(Js + B + K^2/R\right)}}$$

b) $T = 0{,}1$ V/rad $\Rightarrow H(s) = \dfrac{G(s)}{1 + T.G(s)}$

$G(s) = \dfrac{2.A}{s(s+10)} \Rightarrow \boxed{H(s) = \dfrac{2.A}{s(s+10) + 0{,}2A}}$ Es estable $\forall A\ (>0)$

c) $G^{oL}(s) = \dfrac{0{,}2A}{s(s+10)}$



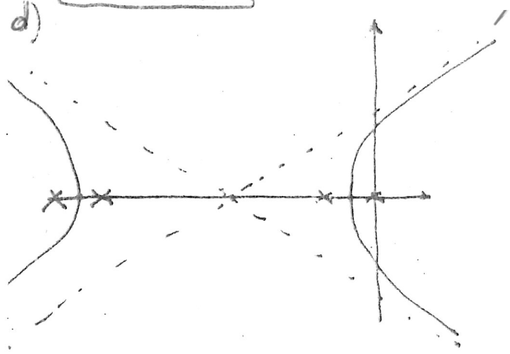
$s^2 + 10s + 0{,}2A = (s+5)^2 \Rightarrow A = 125$

Caso 1) $A = 125$ $(\zeta = 1)$ $t_{R_{10}}^{90} = 0{,}67\,s$

Caso 2) $A = 250$ $\left(\zeta = \frac{\sqrt{2}}{2}\right)$ $t_{R_{10}}^{90} = 0{,}31\,s$

Ambos tienen sobretiro < 5%, pero el primero no cumple la condición en el tiempo de levantamiento (0,67 > 0,5 s) $\Rightarrow \boxed{A = 250}$

d)



$\exists$ valores de A que inestabilizan el sistema.

Cond. de estabilidad : $A < A_{crítico}$

e) $T_m = 0{,}1\,s$
$A = 250$

$$H(s) = \frac{500}{s^2 + 10s + 50}$$

$$\bar{H}(z) = \frac{z-1}{z} \cdot \mathcal{Z}\left\{ \mathcal{L}^{-1}\left(\frac{H(s)}{s} \right)\Big|_{t = kT_m} \right\}$$

$$b_1 = 1 - e^{-0{,}5}(\cos 0{,}5 + \operatorname{sen} 0{,}5)$$
$$b_2 = e^{-1} + e^{-0{,}5}(\operatorname{sen} 0{,}5 - \cos 0{,}5)$$
$$a_1 = -2e^{-0{,}5}\cos 0{,}5$$
$$a_2 = e^{-1}$$

$$\Rightarrow \bar{H}(z) = \frac{0{,}177\,z + 0{,}126}{z^2 - 1{,}065\,z + 0{,}368} \cdot 10$$

$$Y(z) = z^{-2} \cdot \frac{z}{z-1} + 0{,}5\,z^{-1} = \frac{0{,}5(z+1)}{z(z-1)} \quad ; \quad U(z) = \frac{z}{z-1}$$

$$Y(z) = \frac{C(z)\bar{H}(z)}{1 + C(z)\bar{H}(z)} \cdot U(z) \Rightarrow C(z) = \frac{Y(z)}{\bar{H}(z)\left[U(z) - Y(z)\right]}$$

Al sustituir queda

$$\boxed{C(z) = \frac{(z^2 - 1{,}065\,z + 0{,}368)(z+1)}{2(z-1)(z+1/2)(1{,}77\,z + 1{,}26)}}$$

Como la transf. es única, elijo expresarla como $\frac{Y(z)}{U(z)} = \frac{0{,}5(z+1)}{z^2}$

Los polos están ambos en $z=0$
y el sistema es estable ($|z| < 1$ de los polos del lazo cerrado)