$\hookrightarrow \dfrac{50}{0{,}1s^3+5{,}5s^2+25s}$ $\rightarrow$ Dessa eq, temos as matrizes:

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -25 & -5{,}5\end{bmatrix};\ B=\begin{bmatrix}0\\0\\1\end{bmatrix};\ C=[\ 50\ ];\ D=0$$

$$T_s=\frac{4}{\zeta\omega_n}<\frac{1}{p}\ \therefore\ \frac{4}{0{,}5\,\omega_n}<\frac{1}{p}\ \therefore\ \omega_n>8p$$

$\omega_n = 40$

$\hookrightarrow$ polos desejados: $-20 \pm 34{,}64$

$\hookrightarrow$ Polo real $p_3 = -55$

$\hookrightarrow$ encontrando a equação característica

$$(s-p_3)(s-p_2)(s-p_1)\ \therefore$$

$$(s+55)(s+20-j34{,}64)(s+20+j34{,}64)\ \therefore$$

Simplificando, temos a equação característica:

$$(s+55)(s^2+40s+1600)\therefore s^3+40s^2+1600s+55s^2+2200s+88k$$

$$\therefore\ s^3+95s^2+3800s+88000$$

↳ O controlador é $K = [K_1 \ K_2 \ K_3]$

↳ Encontrar os autovalores:

$$\det\left(\begin{bmatrix} s & 0 & 0 \\ 0 & s & 0 \\ 0 & 0 & s \end{bmatrix} - \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -K_1 & -(25+K_2) & -(5{,}5+K_3) \end{bmatrix} \right) \therefore$$

$$\det \begin{bmatrix} s & -1 & 0 \\ 0 & s & -1 \\ K_1 & 25+K_2 & s+5{,}5+K_3 \end{bmatrix} = s^2(s+5{,}5+K_3)+K_1+s(25+K_2)$$

$$\therefore \ s^3+5{,}5s^2+K_3s^2+K_1+25s+K_2s \ \therefore$$

$$s^3+(5{,}5+K_3)s^2+(25+K_2)s+K_1 \quad \therefore \text{ Comparando...}$$

$$\begin{cases} 5{,}5+K_3 = 95 \\ 25+K_2 = 3800 \\ K_1 = 88000 \end{cases} \rightarrow \begin{cases} K_1 = 88000 \\ K_2 = 3775 \\ K_3 = 89{,}5 \end{cases}$$

Se $T(s) = C(sI - A + BK)^{-1} \cdot BJ$ ∴ Quando $T(s \to 0)$:

$$[50] \left(\begin{bmatrix} 0 & -1 & 0 \\ 0 & 0 & -1 \\ 0 & 25 & 5{,}5 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} [88000 \ 3775 \ 89{,}5] \right)^{-1} \cdot \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} J = 1$$

↳ Usamos o matlab a partir daqui