01

$$\begin{cases} M_p = e^{\frac{-\pi \xi}{\sqrt{1-\xi^2}}} \\ t_r\Big|_0^{100\%} = \dfrac{\pi - \arccos\xi}{\omega_n\sqrt{1-\xi^2}} \end{cases}$$

$$\begin{cases} \sigma = \xi\,\omega_n \\ \omega_d = \omega_n\sqrt{1-\xi^2} \end{cases}$$

$$\ln(M_p) = \frac{-\pi\xi}{\sqrt{1-\xi^2}}$$

$$\ln^2(M_p)(1-\xi^2) = \pi^2\xi^2$$

$$\frac{\ln(M_p)}{\sqrt{\pi^2+\ln^2(M_p)}} = \xi$$

$$\omega_n = \frac{\pi - \arccos\xi}{t_r\sqrt{1-\xi^2}}$$

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03) $I = (R - I)\dfrac{K_p s + K_i}{s} \cdot \dfrac{1}{Ls + R}$

$$I\left(\frac{s(Ls+R) + K_p s + K_i}{s(Ls+R)}\right) = \frac{R(s)(K_p s + K_i)}{s(Ls+R)}$$

$$\frac{I(s)}{R(s)} = \frac{K_p s + K_i}{Ls^2 + (R+K_p)s + K_i}$$

os polos são da seguinte função

$$\frac{I(s)}{R(s)} = \frac{X(s)}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$\begin{cases} \dfrac{R+K_p}{L} = 2\xi\omega_n \\ \dfrac{K_i}{L} = \omega_n^2 \end{cases}$$

$$\begin{cases} K_i = L\omega_n^2 \\ K_p = 2\xi\omega_n L - R \end{cases}$$

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04

$$X(s) = \left(R(s)F(s) - X(s)\right)\frac{K_p + K_d s}{ms^2 + bs}$$

$$\left(ms^2 + bs + K_p + K_d s\right) X(s) = R(s)F(s)(K_p + K_d s)$$

$$\frac{X(s)}{R(s)} = \frac{F(s)(K_p + K_d s)}{ms^2 + (b + K_d)s + K_p}$$

sistema padrão

$$G(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$\begin{cases} \dfrac{b + K_d}{m} = 2\xi\omega_n \\ \dfrac{K_p}{m} = \omega_n^2 \end{cases}$$

$$\begin{cases} K_d = 2m\xi\omega_n - b \\ K_p = m\,\omega_n^2 \end{cases}$$

$$\frac{F(s)(K_p + K_d s)}{m} = \omega_n^2$$

$$F(s) = \frac{\omega_n^2 \cdot m}{K_p + K_d s} = \frac{K_p}{K_p + K_d s}$$

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