

# Lab-5. erro estacionário

$$P(s) = \frac{400}{s^2 + 30s + 200}, \quad H(s) = 1$$

a)  $e_{est} = 0,1$  para rampa.

$$e_{est} = \lim_{s \rightarrow 0} s E(s) = \lim_{s \rightarrow 0} s \left( \frac{R(s)}{1 + G(s)} \right)$$

$$e_{est} = 0,1, \quad R(s) = \frac{1}{s^2}, \quad G(s) = K \cdot P(s)$$

$$0,1 = \lim_{s \rightarrow 0} s \left( \frac{\frac{1}{s^2}}{1 + \frac{K \cdot 400}{s^2 + 30s + 200}} \right) = \lim_{s \rightarrow 0} \left( \frac{s^{-1}}{1 + \frac{2400}{s^2 + 30s + 200}} \right)$$

Multiplicando por  $\frac{s}{s}$ :

$$\lim_{s \rightarrow 0} \left( \frac{1}{s + \frac{sK400}{s^2 + 30s + 200}} \right) = 0,1, \quad \text{Aplicando os limites}$$

$$0,1 = \frac{1}{\lim_{s \rightarrow 0} \left( \frac{sK400}{s^2 + 30s + 200} \right)}, \quad \text{como o num} \neq 0 \text{ faremos } K \cdot s = K_1$$

$$0,1 = \frac{1}{\lim_{s \rightarrow 0} \left( \frac{K_1 400}{s^2 + 30s + 200} \right)} = \frac{1}{\frac{K_1 400}{200}} \Rightarrow \frac{K_1 400}{200} = \frac{1}{0,1} \Rightarrow K_1 = \frac{200 \cdot 10}{400} = 5$$

$$\text{Como } K_1 = K \cdot s \Rightarrow K = \frac{5}{s}$$