Tarefa 2

Para o sistema dinâmico abaixo, encontre K e Km necessários para que o sobressinal seja, ao menos, menor que 5% e o tempo de assentamento (2%) menor que 5 segundos. Utilize Matlab/Simulink para verificar os resultados

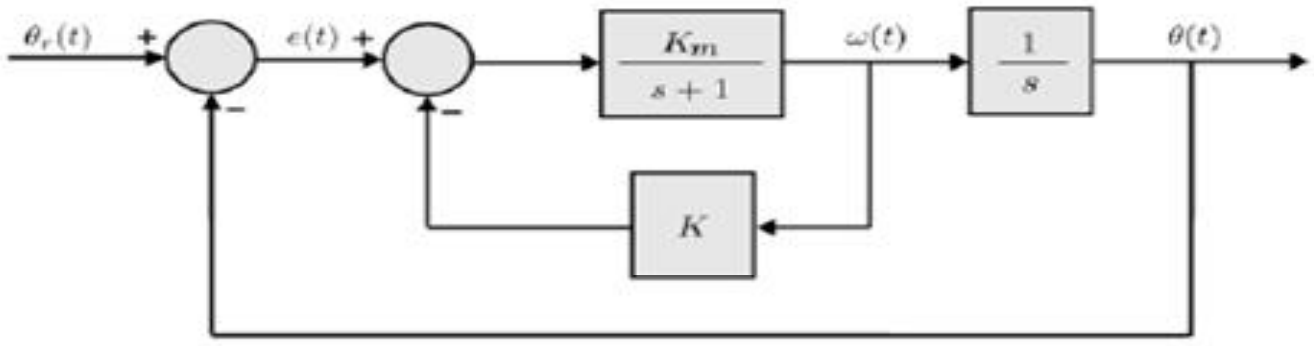


Figura 3.31 Servossistema com realimentação tacométrica.

$$G(s)*H(s) = \frac{Km}{(s+1)}$$

$$H(s) = K$$

MP(%) < 5%

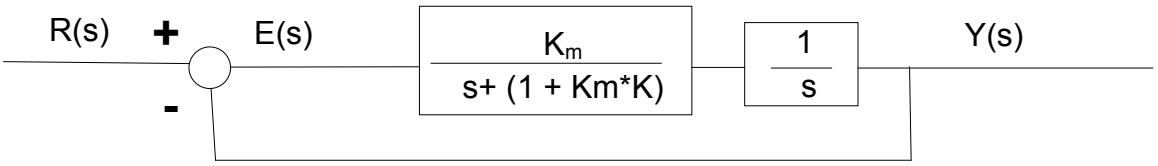
Ts < 5 segundos

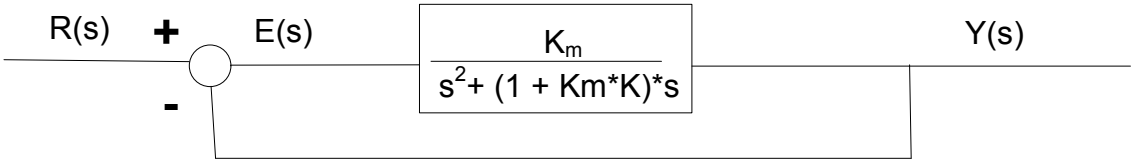
Máximo Pico Percentual MP%

$$MP = 100^* e^{-(\xi/\sqrt{(1-\xi^2)})*\P}$$

Tempo de estabelecimento: ts

$$t_s = 4*T = \frac{4}{\xi*\omega_n} = \frac{4}{\sigma}$$ Critério de 2%





$$G(s) = \frac{K_m}{s^2+(1+K_m*K)*s+K_m}$$

Máximo Pico Percentual MP%

$$MP = 100\, e^{-(\xi/\sqrt{1-\xi^2})*\pi}$$

MP(%) < 5%

$$\ln(\; e^{-(\xi/\sqrt{1-\xi^2})*\pi}\;) < \ln(\; MP\;\%)$$

A = | ln(MP%) |

$$-(\xi/\sqrt{1-\xi^2})*\pi < -A$$

$$\xi*\pi > A*\sqrt{1-\xi^2)}$$

$$\xi^2*\pi^2/A^2 > 1-\xi^2$$

$$\xi^2(\pi^2/A^2+1) > 1$$

$$\xi^2 > \frac{1}{(\pi^2/A^2+1)}$$

$$\xi > \sqrt{\frac{1}{(\pi^2/A^2+1)}}$$

Exemplo:

MP% = 5% = 0,05

A = 2,9957 = | ln(0,05) |

¶²/ A² + 1 = 2,1039 $1/\sqrt{(\pi^2/A^2+1}=$

ξ > 0,6894

Tempo de acomodação : ts

$$t_s = 4*T = \frac{4}{\xi*\omega_n} = \frac{4}{\sigma}$$ Critério de 2%

ts < 5 segundos

ξ > 0,6901

$$\frac{4}{\sigma} < ts = 5 \text{ segundos} \qquad \sigma > \frac{4}{ts} \qquad \xi*\omega_n > \frac{4}{ts}$$

$$\sigma > \frac{4}{5} \qquad \omega_n > \frac{4}{5*\xi}$$

Exemplo:

ξ > 0,6901

$$\omega_n > \frac{4}{5*\xi} \qquad \omega_n > \frac{4}{5*0,7} \qquad \omega_n > 1,1592$$

$$\omega_n > \frac{4}{5*0,7}$$

ω_n = 1, 1592

Valor adotado

$$\frac{Y(s)}{R(s)} = \frac{K_m}{s^2+(1+K_m*K)*s+K_m}$$

$$\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2+2*\xi*\omega_n s+\omega_n^2}$$

Calculo do valor da constante Km:

Usando ω_n = 1,1592 $K_m = \omega_n^2$ $K_m = 1,1592^2$ $K_m = 1,3438$

ξ = 0,6901

ω_n^2 = 1,3438

Calculo do valor da constante K:

$2*\xi*\omega_n = (1+K_m*K) =$

$K = (\; 2*\xi*\omega_n - 1) / K_m$

$2*\xi*\omega_n = 2*0,7*1,14 = 1,600$

K = (2*1,1592*1,3438 – 1) /1,3438

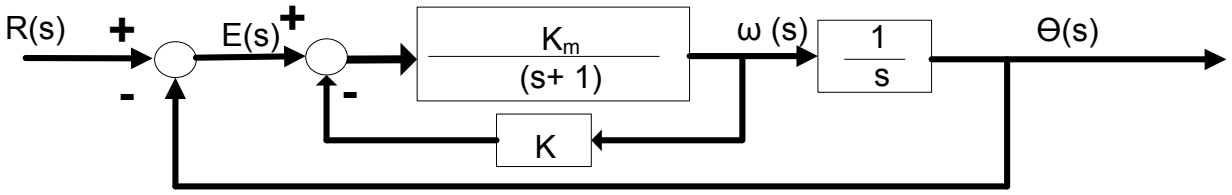
K = 0,4465

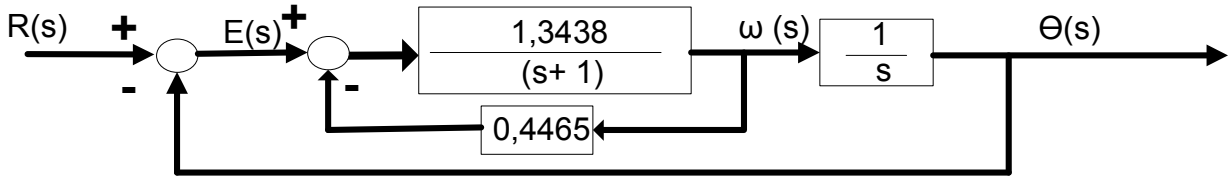
Resumo: (1) $\xi > \sqrt{\frac{1}{(\pi^2 / A^2 + 1)}}$ (2) $\omega_n > \frac{4}{ts*\xi}$ (3) $K_m = \omega_n^2$

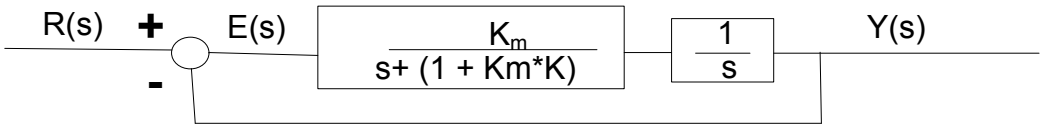
A = | ln(MP%) | (4) $K = (2*\xi*\omega_n - 1) / K_m$ (5) $2*\xi*\omega_n = (1 + K_m*K) =$

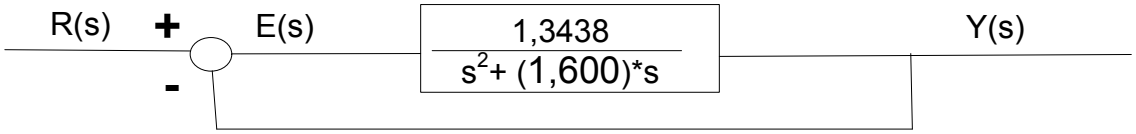
Exemplo: MP%) <5% ts< 5s critério 2%

$\xi = 0{,}6901$ $\omega_n = 1{,}1592$ $K_m = 1{,}3438$ $K = 0{,}4465$ $2*\xi*\omega_n = 1{,}600$



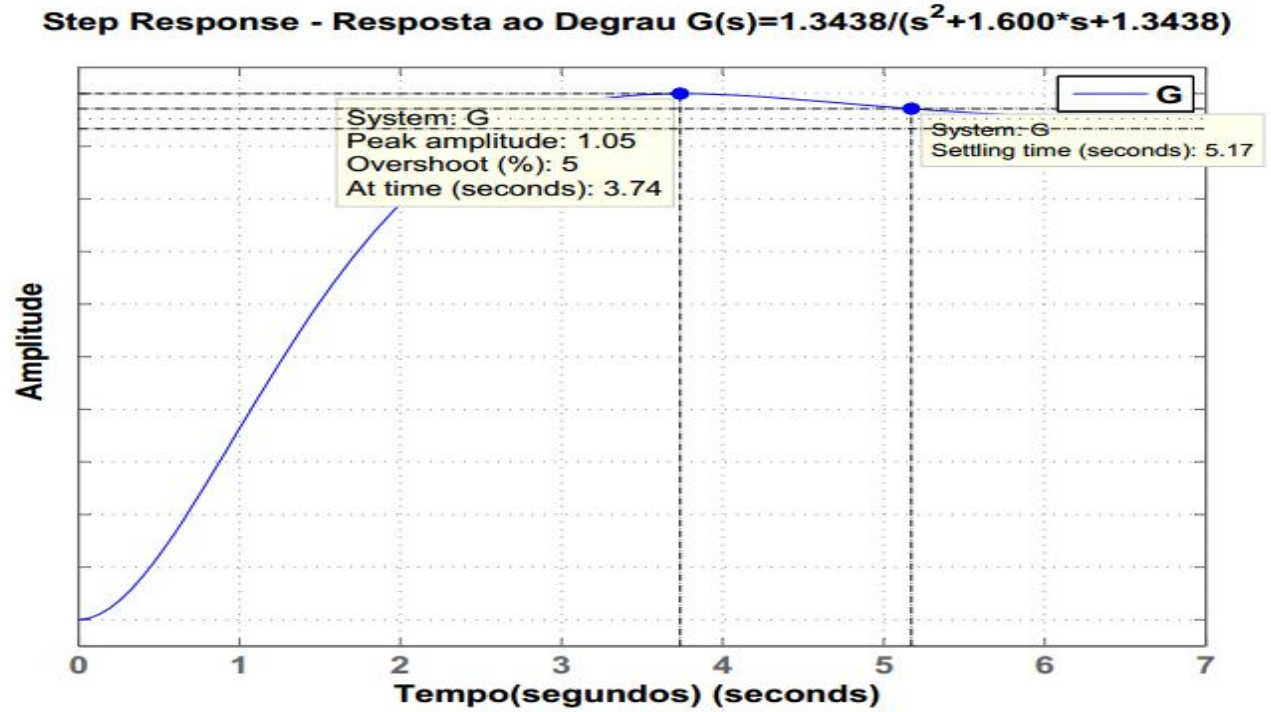






$$\frac{Y(s)}{R(s)} = \frac{1{,}3438}{s^2 + (1{,}600)*s + 1{,}3438}$$

$$\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2*\xi*\omega_n s + \omega_n^2}$$

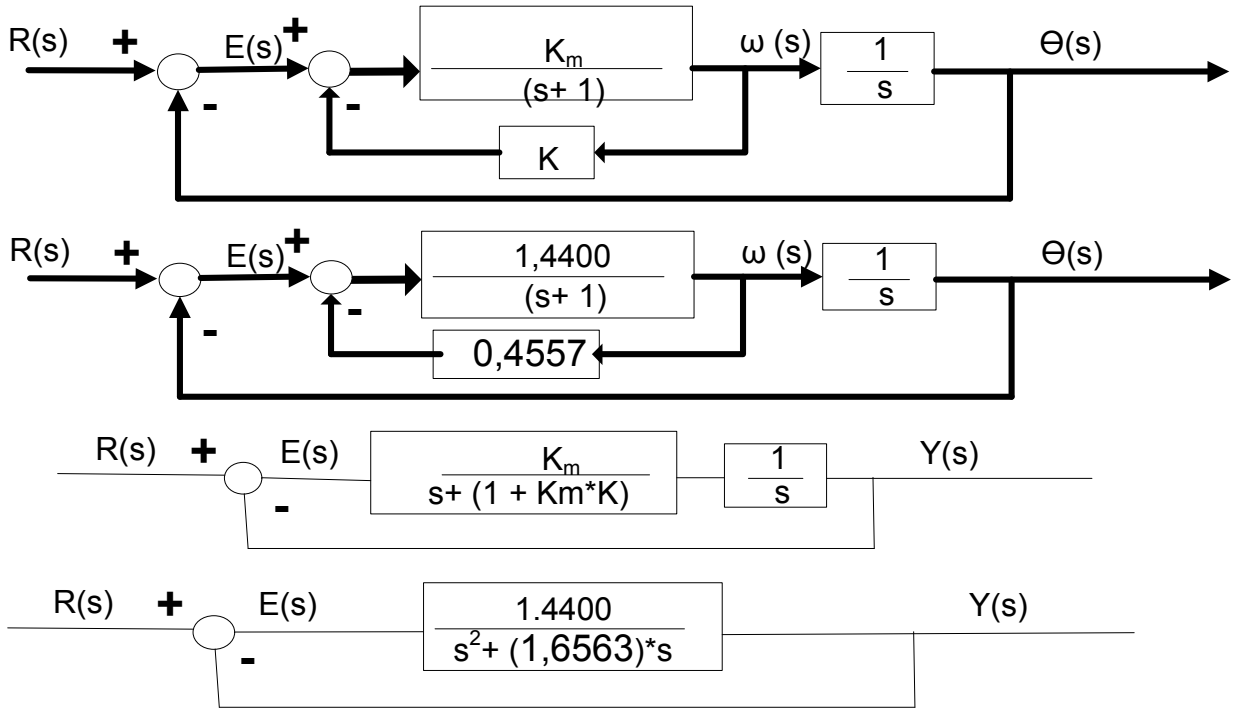


Resumo: (1) $\xi > \sqrt{\frac{1}{(\pi^2 / A^2 + 1)}}$ (2) $\omega_n > \frac{4}{ts*\xi}$ (3) $K_m = \omega_n^2$

A = | ln(MP%) | (4) $K = (2*\xi*\omega_n - 1) / K_m$ (5) $2*\xi*\omega_n = (1 + K_m*K) =$

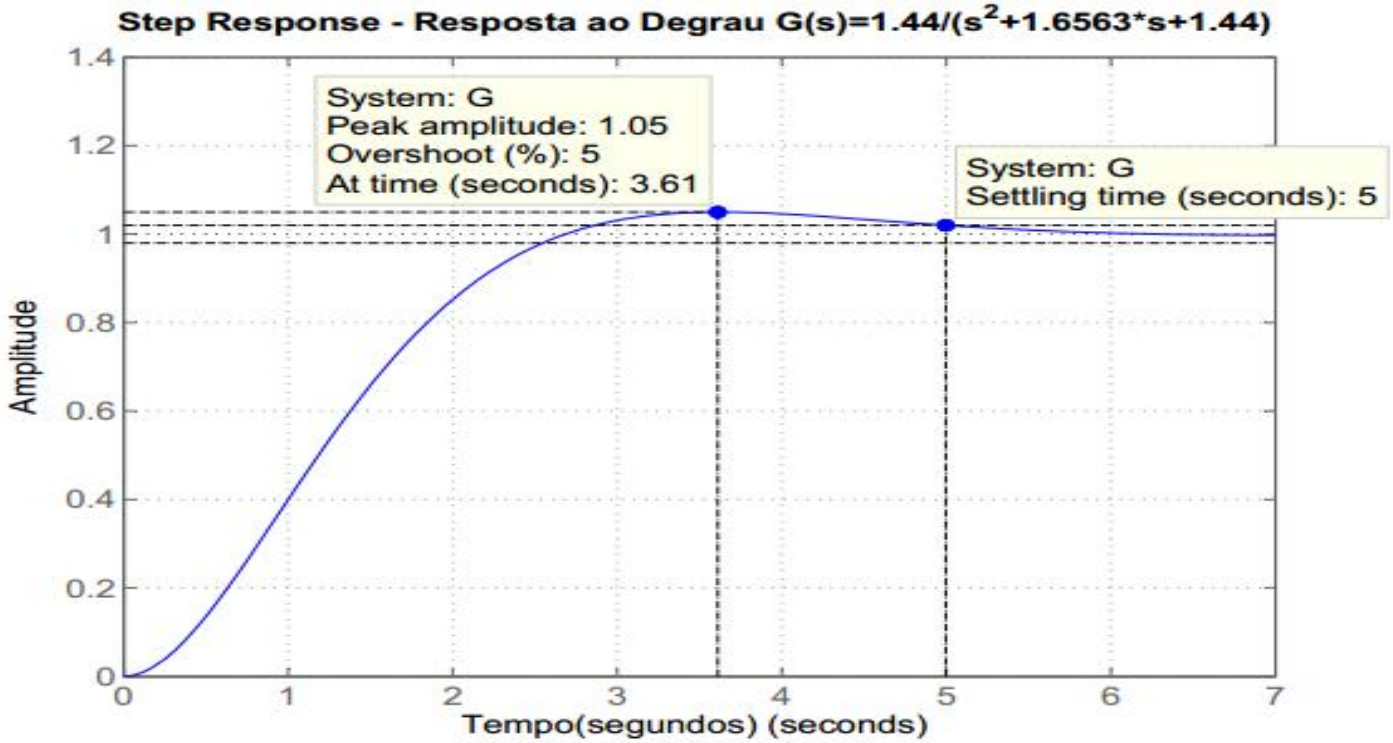
Exemplo: MP%) <5% ts< 5s critério 2%

$\xi = 0{,}6901$ $\omega_n = 1.2000$ $K_m = 1{,}4400$ $K = 0{,}4557$ $2*\xi*\omega_n = 1{,}6563$



$$\frac{Y(s)}{R(s)} = \frac{1.4400}{s^2 + (1{,}6563)*s + 1{,}3438}$$

$$\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2*\xi*\omega_n s + \omega_n^2}$$

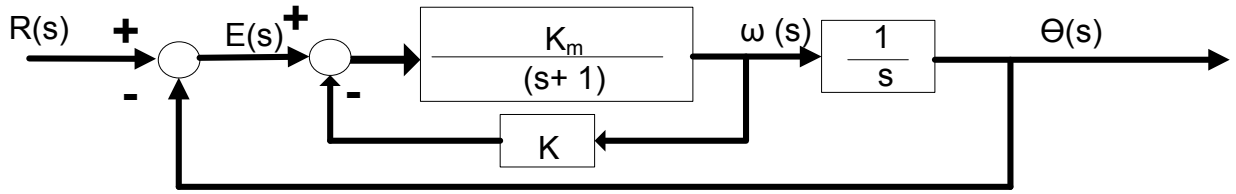


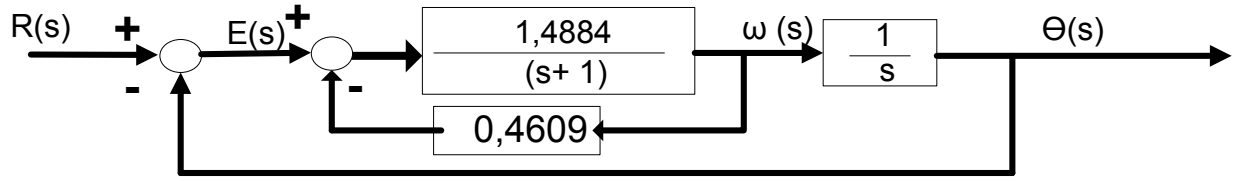
Resumo: (1) $\xi > \sqrt{\frac{1}{(\pi^2 / A^2 + 1)}}$ (2) $\omega_n > \frac{4}{ts*\xi}$ (3) $K_m = \omega_n^2$

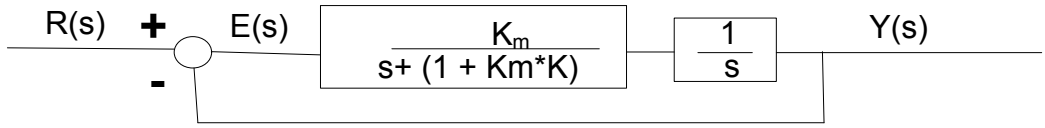
A = | ln(MP%) | (4) $K = (2*\xi*\omega_n - 1) / K_m$ (5) $2*\xi*\omega_n = (1 + K_m*K) =$

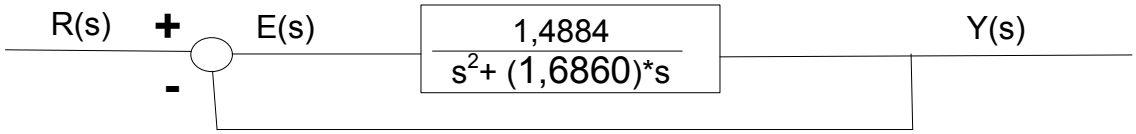
Exemplo: MP%) <5% ts< 5s critério 2%

$\xi = 0.691$ $\omega_n = 1.22$ $K_m = 1,4884$ $K = 0,4609$ $2*\xi*\omega_n = 1,6860$



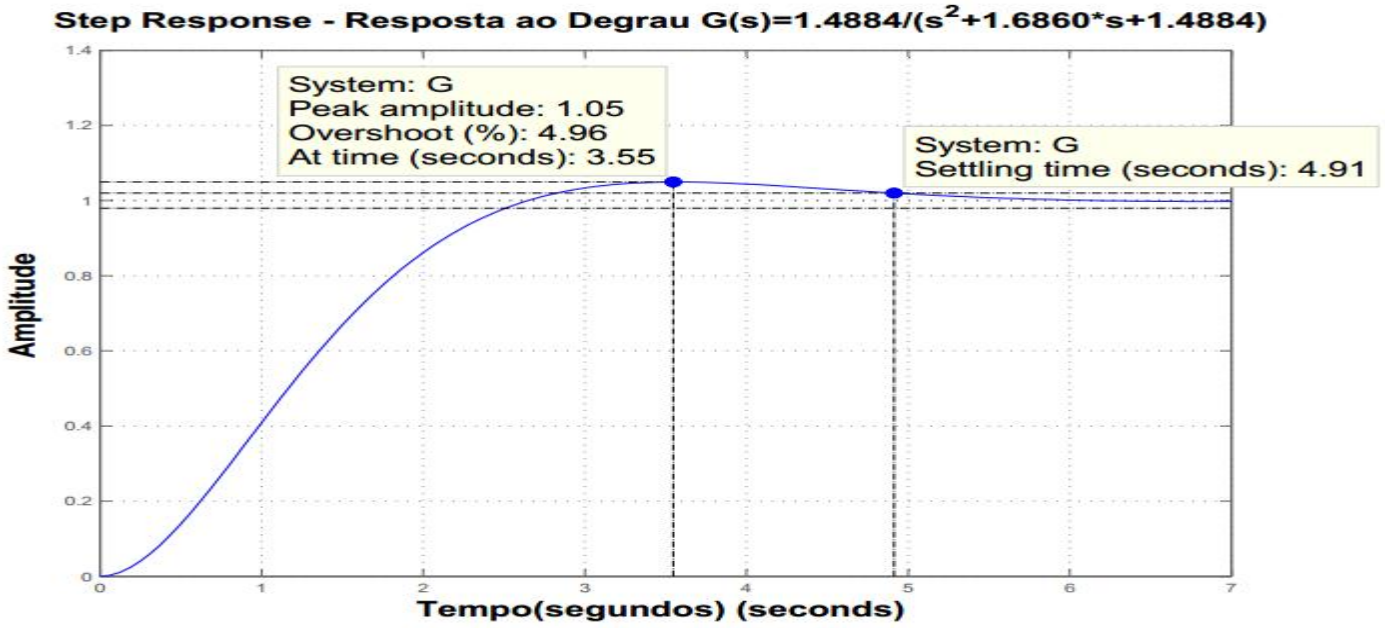


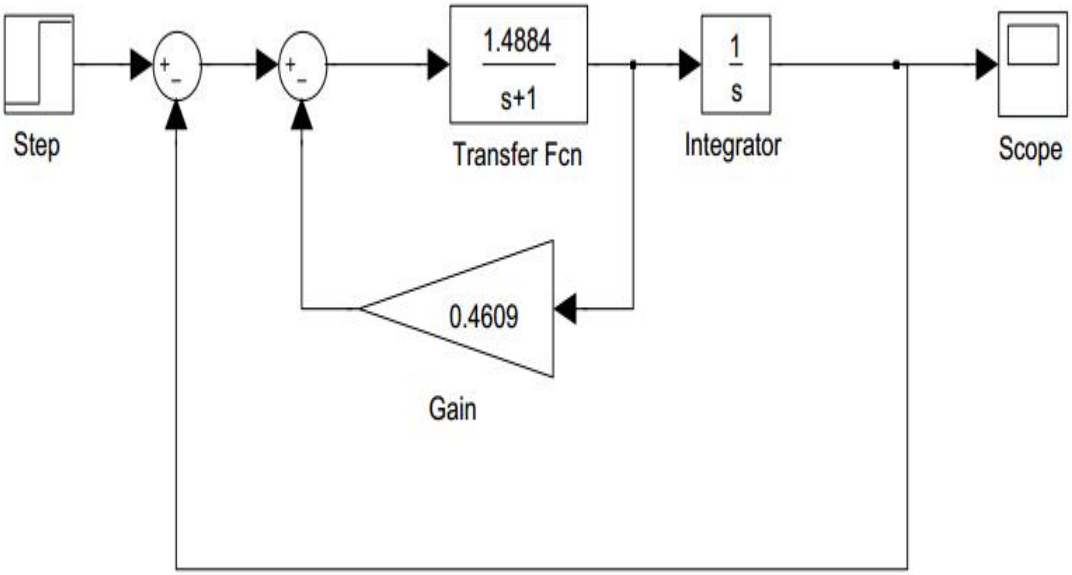


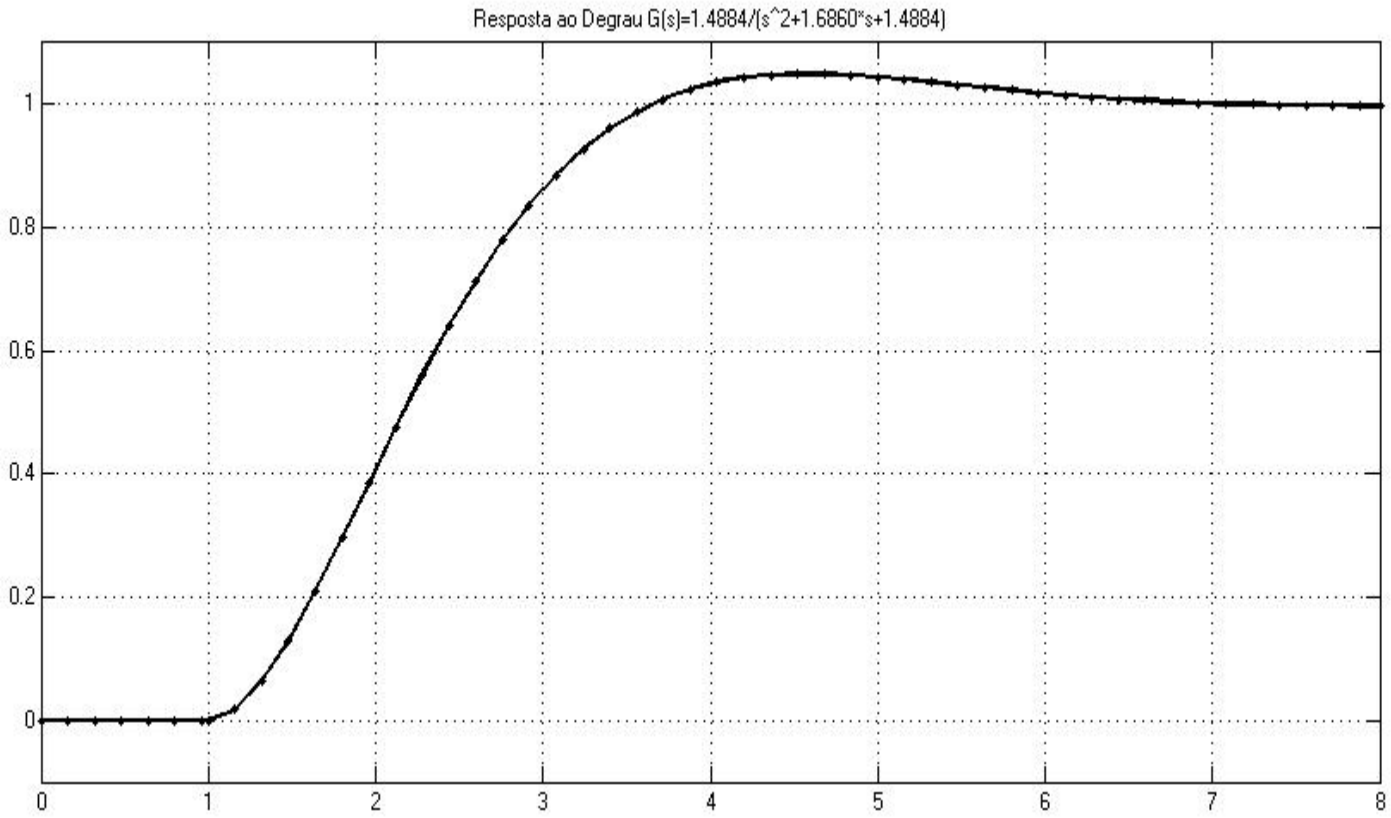


$$\frac{Y(s)}{R(s)} = \frac{1,4884}{s^2 + (1,6860)*s + 1,4884}$$

$$\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2*\xi*\omega_n s + \omega_n^2}$$




1.4884
s+1
Transfer Fcn
1
s
Integrator
Step
Scope
0.4609
Gain


Resposta ao Degrau G(s)=1.4884/(s^2+1.6860*s+1.4884)
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8