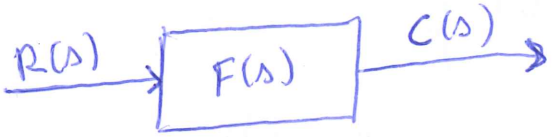
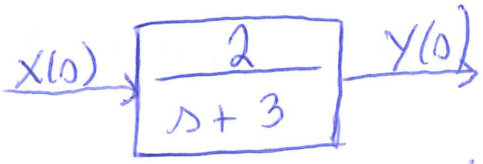
Sistemas de Controle I

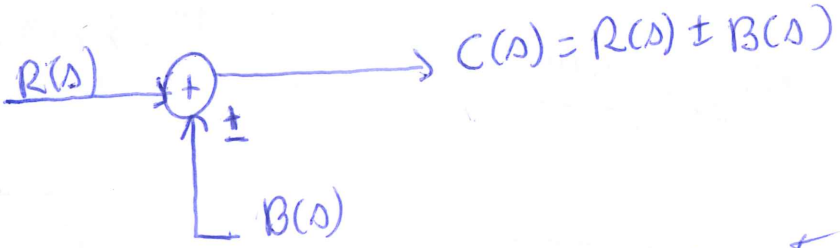
Diagrama de Blocos

* **Blocos Funcionais**: indica a operação matemática que age sobre o sinal de entrada para produzir o sinal de saída.

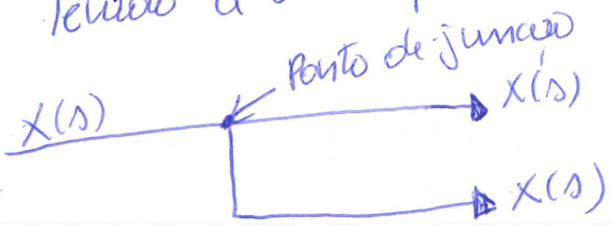




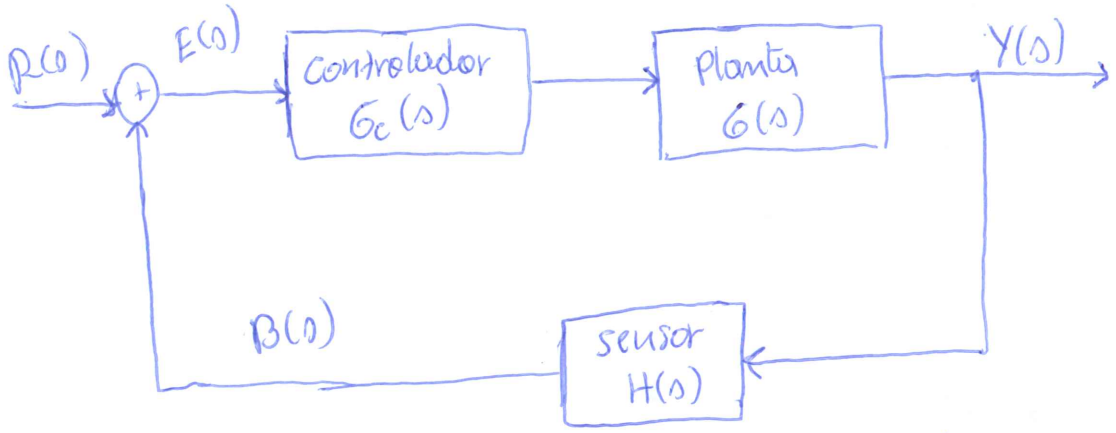
* **Somador**: Produz como sinal de saída a soma dos sinais de entrada.



* **Ponto de Junção**: ponto onde um sinal é captado para ser levado a outro ponto do diagrama de blocos

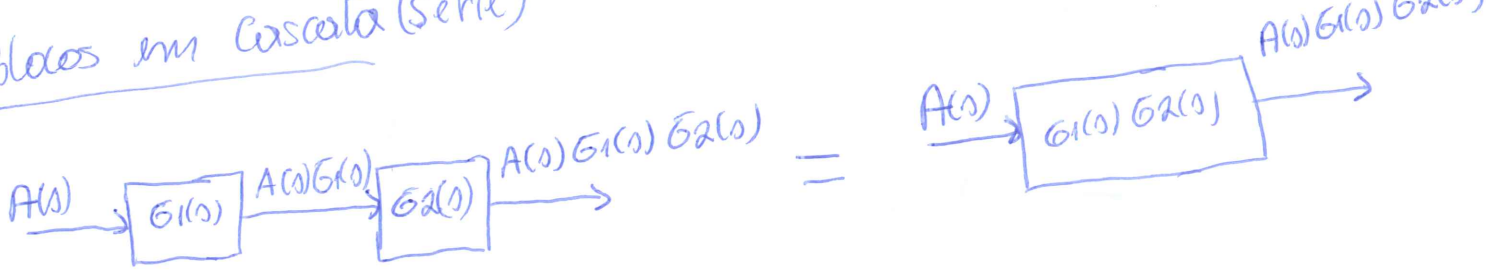


* Terminologia Básica

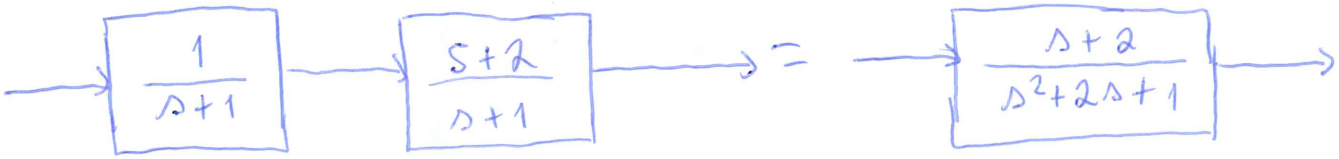


- Planta ou Processo: sistema a ser controlado
- Realimentação: ação do sinal de saída sobre o sinal de referência ($R(s)$) para gerar o sinal de erro ($E(s)$)

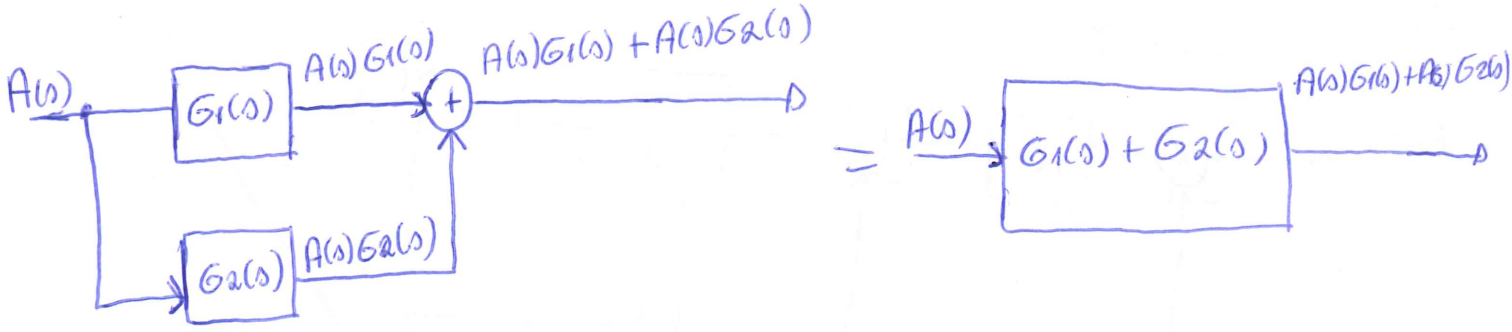
• Blocos em Cascata (Série)



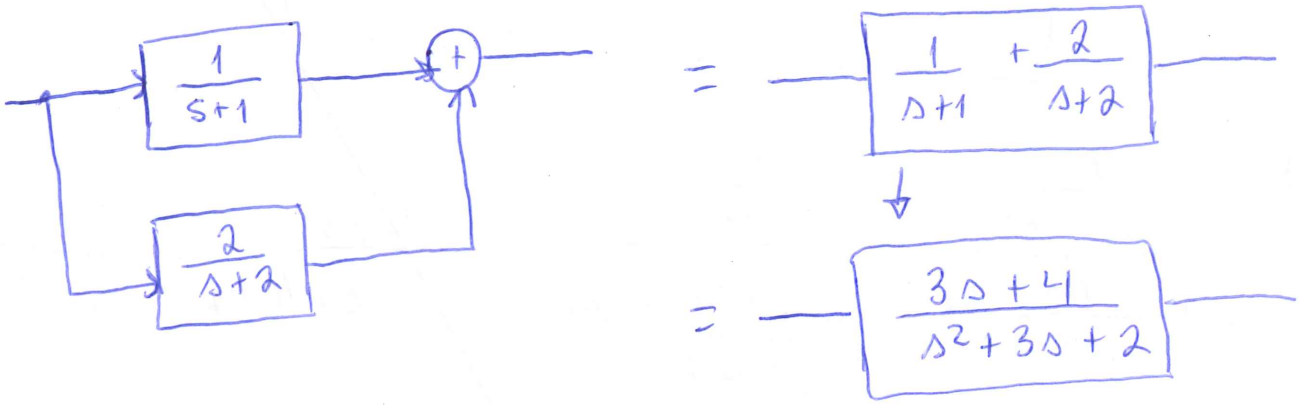
EX:



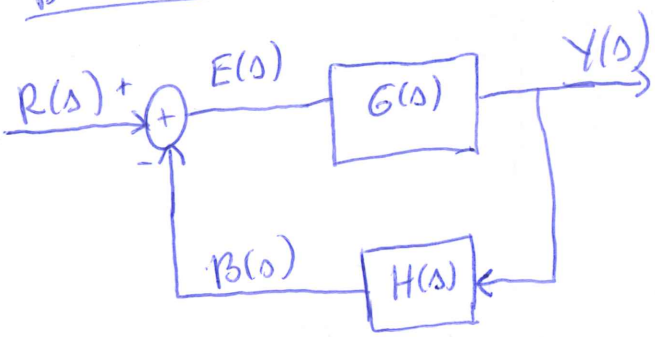
* Blocos em Paralelo:



Ex.



* Blocos com Realimentação:



$Y(s) = G(s)R(s) - G(s)H(s)Y(s)$

$Y(s) + G(s)H(s)Y(s) = G(s)R(s)$

$(1 + G(s)H(s))Y(s) = G(s)R(s)$

$$\frac{Y(s)}{R(s)} = \frac{G(s)}{1 + G(s)H(s)} = T(s)$$

Obter $\frac{Y(s)}{R(s)} = T(s)$

$E(s) = R(s) - B(s)$ (1)

$B(s) = H(s)Y(s)$ (2)

$Y(s) = G(s)E(s)$ (3)

Sub. (1) em (3)

$Y(s) = G(s)(R(s) - B(s))$ (4)

Sub. (2) em (4)

$Y(s) = G(s)(R(s) - H(s)Y(s))$

* Redução de Diagrama de Blocos

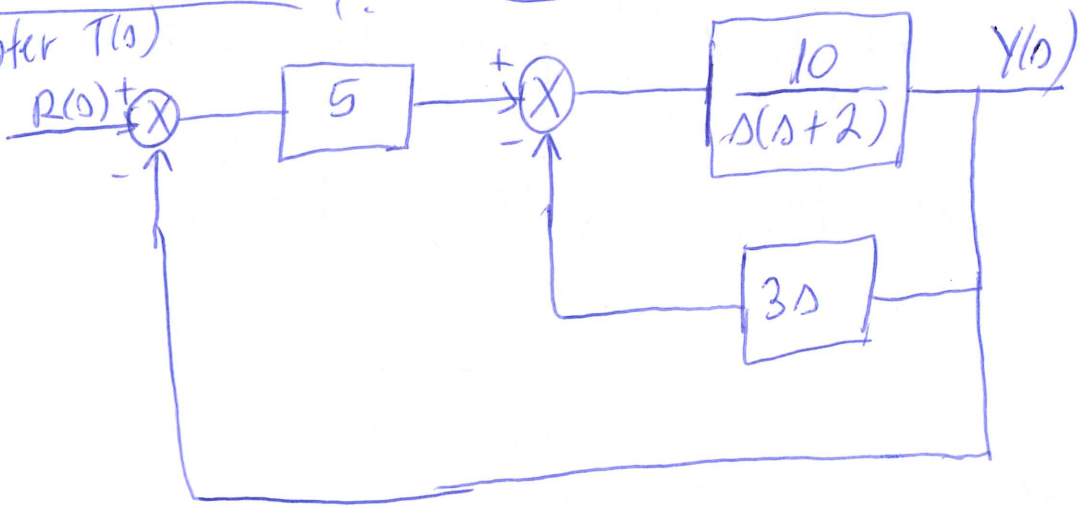
- Obter $T(s)$ a partir da redução.

Ex1:

$$\frac{Y(s)}{R(s)} = T(s) = \frac{G(s)}{1+G(s)H(s)} \cdot \quad H(s)=1 \quad \frac{\frac{200}{s(s+200)}}{1+\frac{200}{s(s+200)}} = \frac{\frac{200}{s(s+200)}}{\frac{s(s+200)+200}{s(s+200)}}$$

$$\boxed{T(s) = \frac{200}{s^2+200s+200}}$$

Ex2: Obter $T(s)$

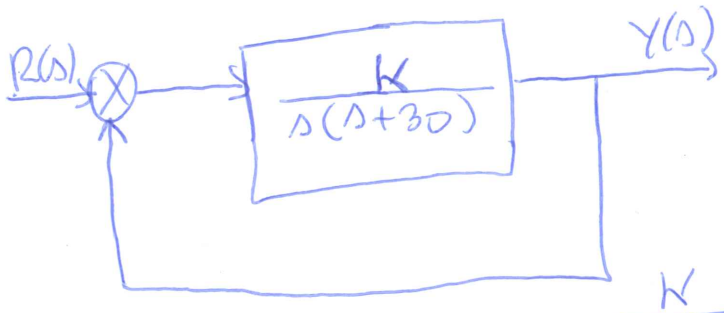


$$T_1(s) = \frac{\frac{10}{s(s+2)}}{1+\frac{10}{s(s+2)} \cdot 3s} = \frac{\frac{10}{s(s+2)}}{\frac{s(s+2)+30}{s(s+2)}} = \frac{10}{s^2+2s+30}$$

$$\boxed{T_1(s) = \frac{10}{s^2+32s}}$$

$$T(s) = \frac{\frac{10}{s^2+32s}}{1+\frac{10}{s^2+32s}} = \frac{\frac{10}{s^2+32s}}{\frac{s^2+32s+10}{s^2+32s}} = \boxed{\frac{10}{s^2+32s+10}} \quad //$$

Ex3: Obtenha o valor do ganho K necessário para fazer o sistema abaixo atingir 10% de sobressinal.



$$T(s) = \frac{G(s)}{1+G(s)H(s)} = \frac{\frac{K}{s(s+30)}}{1+\frac{K}{s(s+30)}} = \frac{\frac{K}{s(s+30)}}{\frac{s(s+30)+K}{s(s+30)}}$$

$$\boxed{T(s) = \frac{K}{s^2+30s+K}}$$

$M_p = 10\% = 0{,}1$

$\omega_n = \sqrt{K}$

$2\xi\omega_n = 30$

$2\xi\sqrt{K} = 30$

$\sqrt{K} = \frac{30}{2\xi}$

$K = \left(\frac{30}{2\xi}\right)^2 \rightarrow K = \left(\frac{30}{2 \cdot 0{,}59}\right)^2 = \boxed{646{,}36}$

$$x = \left(\frac{\ln(M_p)}{\pi}\right)^2 = \left(\frac{\ln(0{,}1)}{\pi}\right)^2 = \boxed{0{,}537}$$

$$\xi = \sqrt{\frac{x}{1+x}} = \sqrt{\frac{0{,}537}{1{,}537}} = \boxed{0{,}59}$$

Logo $\boxed{T(s) = \frac{646{,}36}{s^2+30s+646{,}36}}$ //