Tarefa 3

Para o sistema dinâmico abaixo, encontre os polos da malha fechada e o erro em regime permanente para: (Utilize Matlab/Simulink para verificar os resultados)

- r(t)= degrau unitário e d(t)=0
- d(t)= degrau unitário e r(t)=0
- r(t)= rampa unitária e d(t)=0
- d(t)= rampa unitária e r(t)=0
- Com amplificador C(s)=10/s refaça os itens (a),(b),(c) e (d)

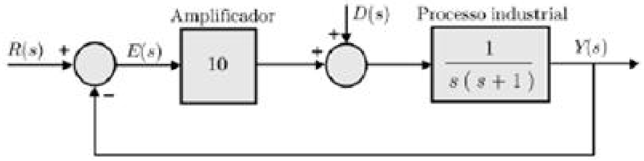
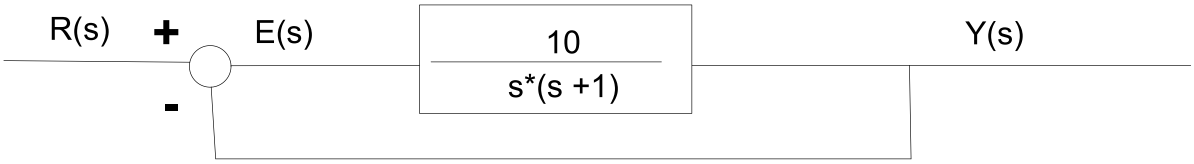


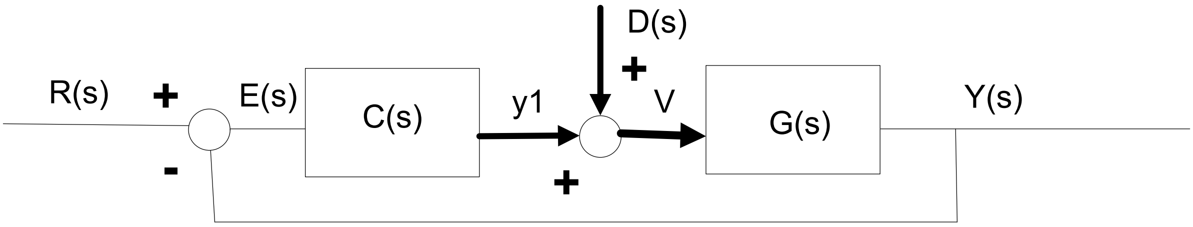
Figura 3.47 Processo industrial com entradas de referência $R(s)$ e de perturbação $D(s)$.



$$\frac{Y(s)}{R(s)} = \frac{C(s)*G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{R(s)} = \frac{10}{s^2 + s + 10}$$

D(s) = 0



(1) $Y(s) = G(s) * V$

(2) $E(s) = - Y(s)$

(3) $Y1(s) = C(s) * E(s)$

(4) $Y1(s) = C(s) * (-Y(s))$

(5) $V(s) = D(s) + Y1(s)$

(6) $V(s) = D(s) - C(s)*Y(s)$

(7) $Y(s) = G(S) * [D(s) - C(s)*Y(s)]$

(8) $Y(s) + Y(s) *G(s)*C(s) = G(s)*D(s)$

(9) $Y(s) (1 + G(s)*C(s)) = G(s)*D(s)$

$$\frac{Y(s)}{D(s)} = \frac{G(s)}{1 + G(s)*C(s)}$$

R(s) = 0

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) \qquad D(s) = 0$$

$$E(s) = R(s) - Y(s) \qquad D(s) = 0$$

$$E(s) = R(s) - \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s)$$

$$E(s) = - Y(s) \qquad R(s) = 0$$

$$E(s) = \frac{- G(s)}{1 + G(s)*C(s)} *D(s)$$

$$E(s) = \frac{R(s)* (1 + G(s)*C(s)) - C(s)*G(s)*R(s)}{1 + G(s)*C(s)}$$

$$E(s) = \frac{R(s)}{1 + G(s)*C(s)}$$

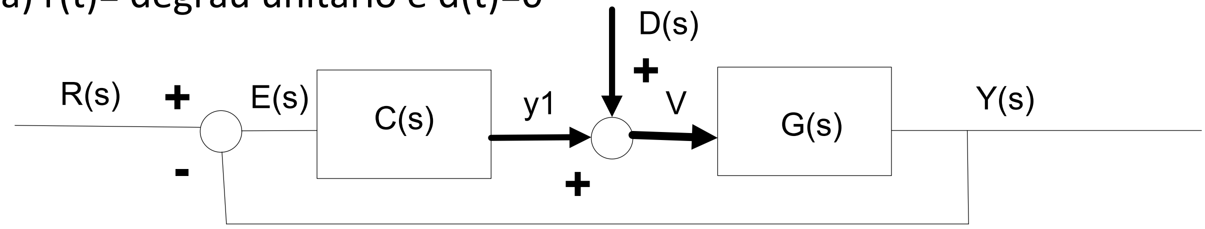
$$Ess = \lim_{s \to 0} \frac{s *R(s)}{1 + G(s)*C(s)} \qquad D(s) = 0$$

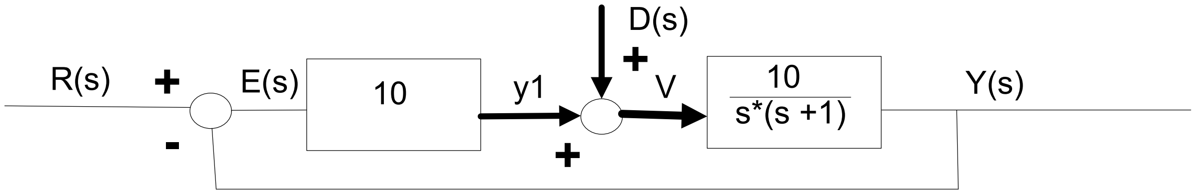
$$Ess = \lim_{s \to 0} \frac{- s*G(s)}{1 + G(s)*C(s)} *D(s) \qquad R(s) = 0$$

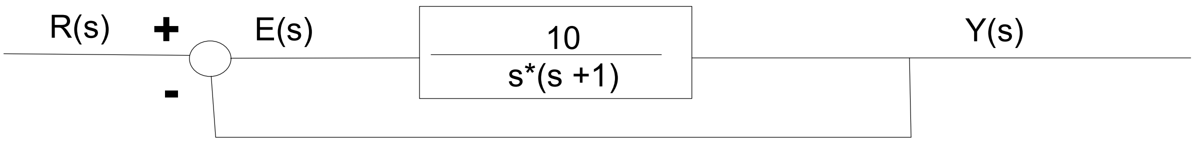
Item(a)

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

a) r(t)= degrau unitário e d(t)=0







$$\frac{Y(s)}{R(s)} = \frac{C(s)*G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{R(s)} = \frac{10}{s^2 +s +10} \qquad D(s) = 0 \qquad R(s) = 1/s$$

$$Ess = \lim_{s\to 0} \frac{s *R(s)}{1 + G(s)*C(s)} \qquad D(s) = 0$$

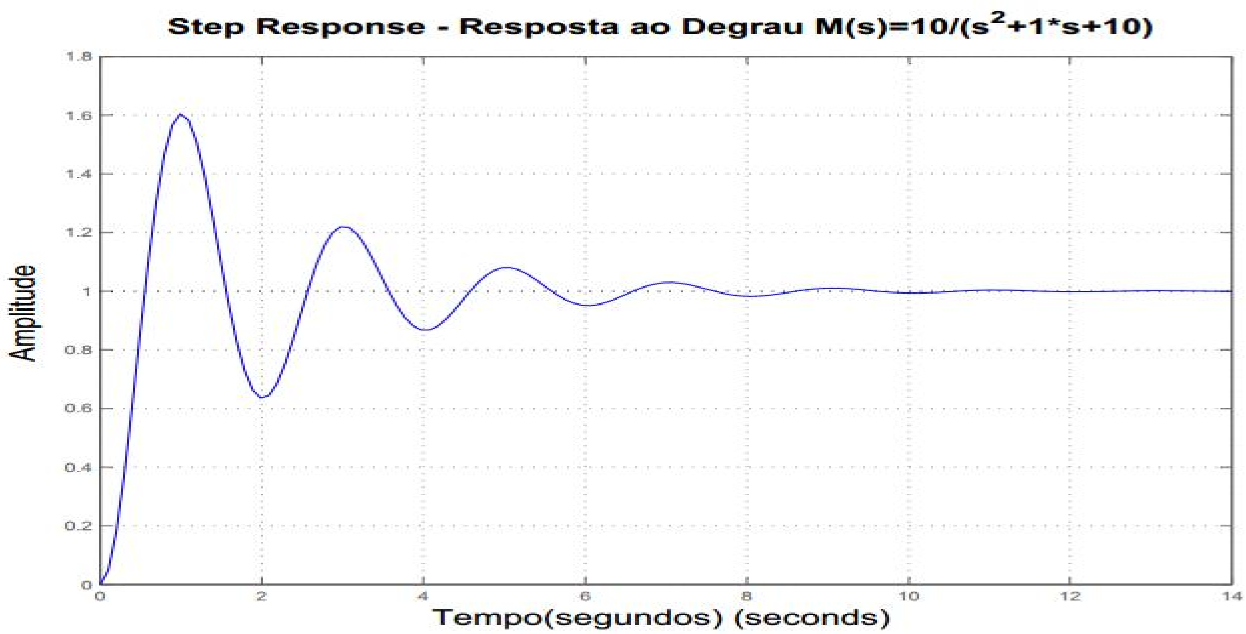
$$A = \lim_{s\to 0} [1 + G(s)*C(s)]$$

$$Ess = \lim_{s\to 0} \frac{\not{s}}{[1 + G(s)*C(s)] * \not{s}} \qquad D(s) = 0$$

$$A = \lim_{s\to 0} 1 + \frac{10}{s*(s +1)} = \infty$$

Ess = 0

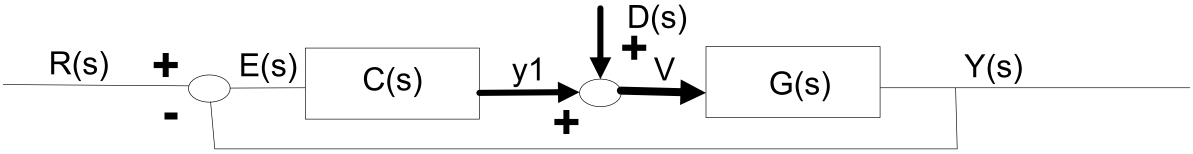
$$Ess = \lim_{s\to 0} \frac{1}{\lim_{s\to 0} [1 + G(s)*C(s)]} = \frac{1}{A}$$

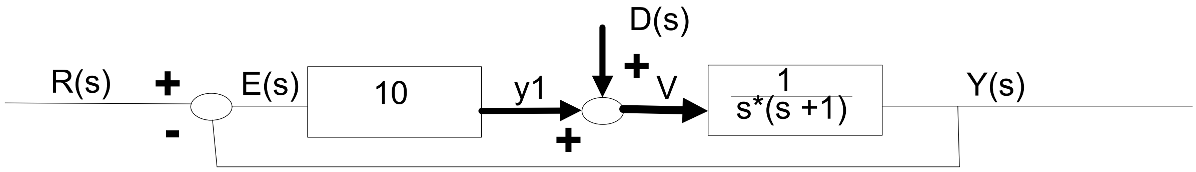


Item(b)

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

b) d(t)= degrau unitário e r(t)=0





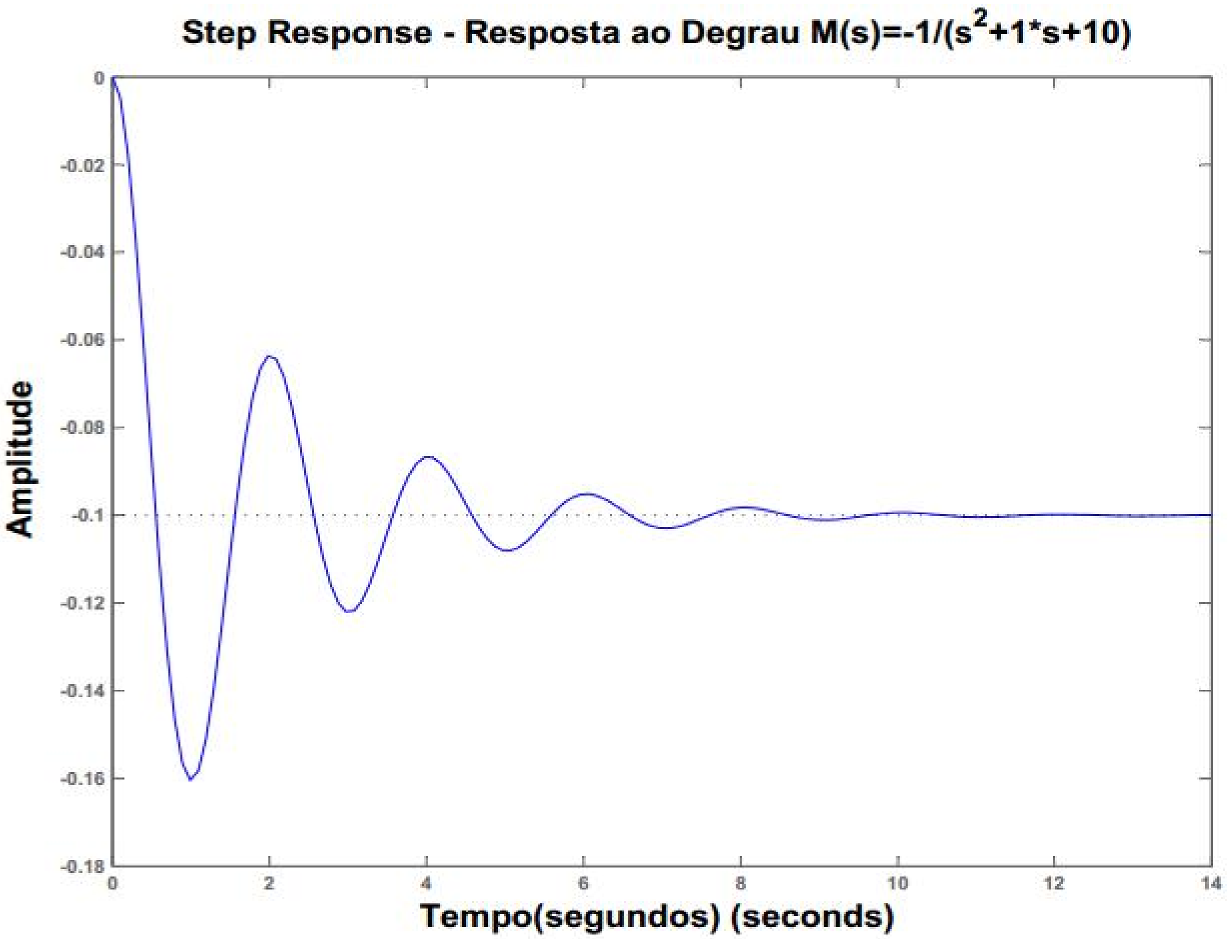
$$\frac{Y(s)}{D(s)} = \frac{G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{D(s)} = \frac{1}{s^2 +s +10} \qquad D(s) = 1/s \quad R(s) = 0$$

$$Ess = \lim_{s\to 0} \frac{- s *G(s)}{1 + G(s)*C(s)} *D(s) \qquad R(s) = 0$$

$$Ess = \lim_{s\to 0} \frac{-s* 1}{s^2 +s +10} * \frac{1}{s}$$

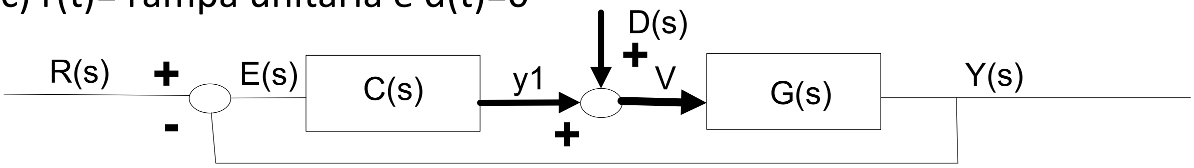
Ess = - 1/10

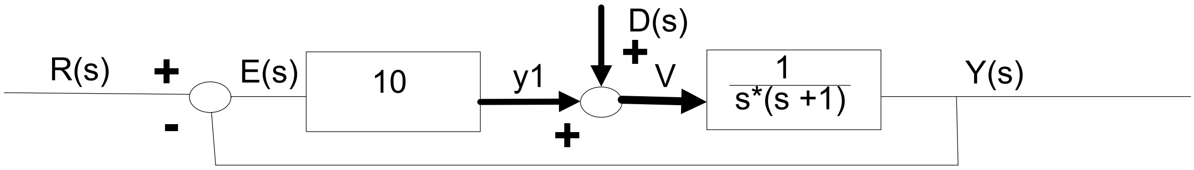


Item(c)

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

c) r(t)= rampa unitária e d(t)=0





$$\frac{Y(s)}{R(s)} = \frac{C(s)*G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{R(s)} = \frac{10}{s^2 +s +10} \qquad D(s) = 0 \quad R(s) = 1/s^2$$

$$Ess = \lim_{s \to 0} \frac{s *R(s)}{1 + G(s)*C(s)} \qquad D(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{\not{s}}{[1 + G(s)*C(s)] * \not{s}^2} \qquad D(s) = 0$$

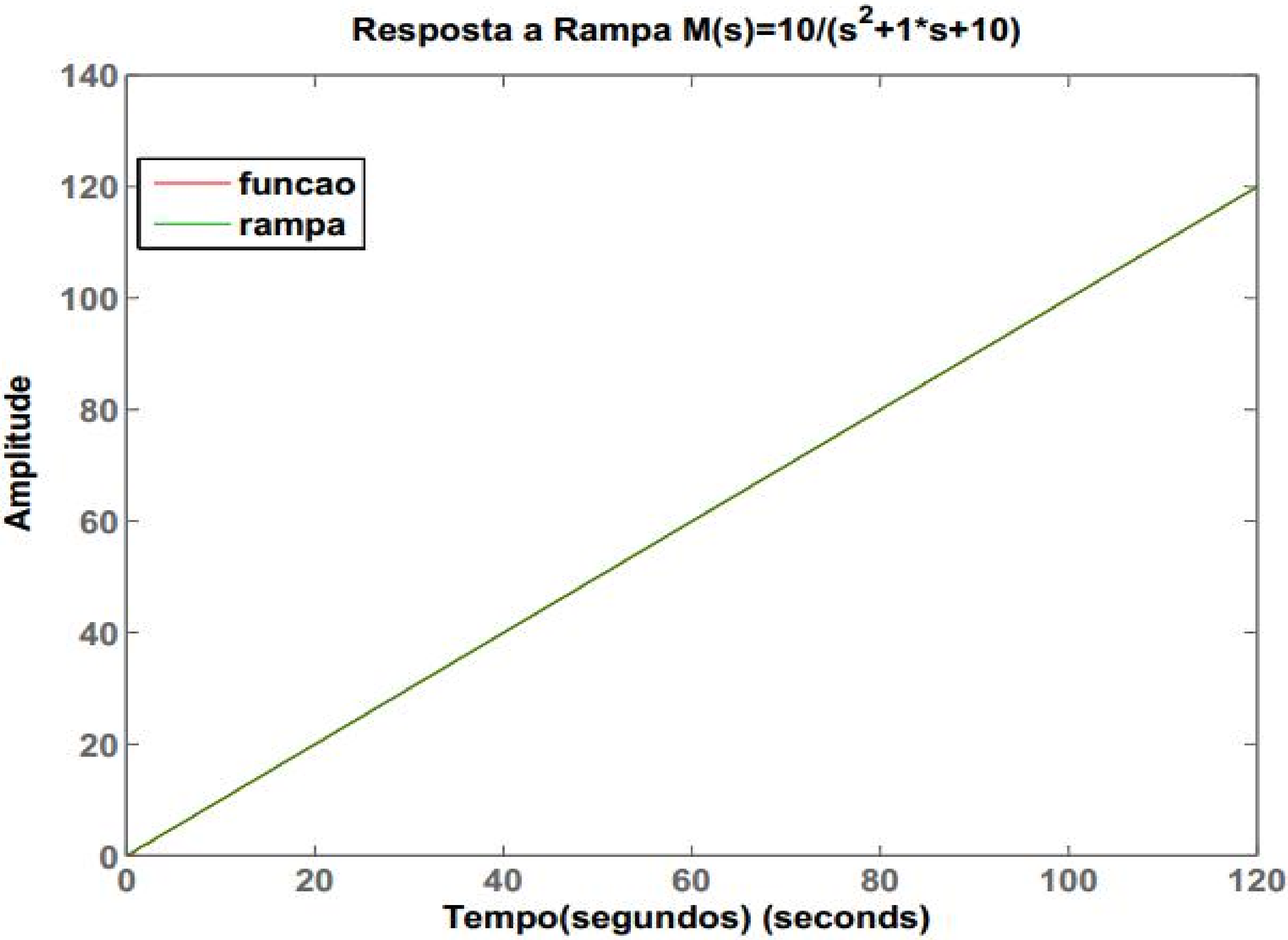
$$Ess = \lim_{s \to 0} \frac{1}{\lim_{s \to 0} [1 + G(s)*C(s)] * s} = \frac{1}{A}$$

$$A = \lim_{s \to 0} [1 + G(s)*C(s)]$$

$$A = \lim_{s \to 0} \left[1 + \frac{10}{\not{s}*(s +1)} *\not{s}\right] = 11$$

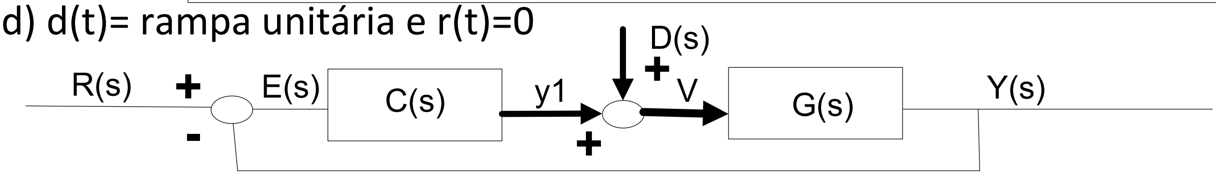
$$\lim_{s \to 0} \frac{10}{\not{s}*(s +1)} *\not{s}$$

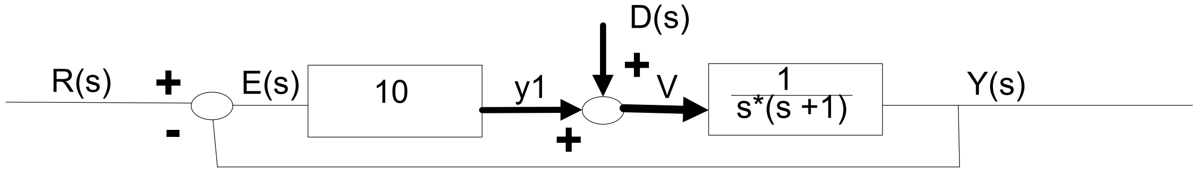
$$Ess = 1/11$$



Item(d) $Y(s) = \dfrac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \dfrac{G(s)}{1 + G(s)*C(s)} *D(s)$

d) d(t)= rampa unitária e r(t)=0





$$\frac{Y(s)}{D(s)} = \frac{G(s)}{1 + G(s)*C(s)}$$

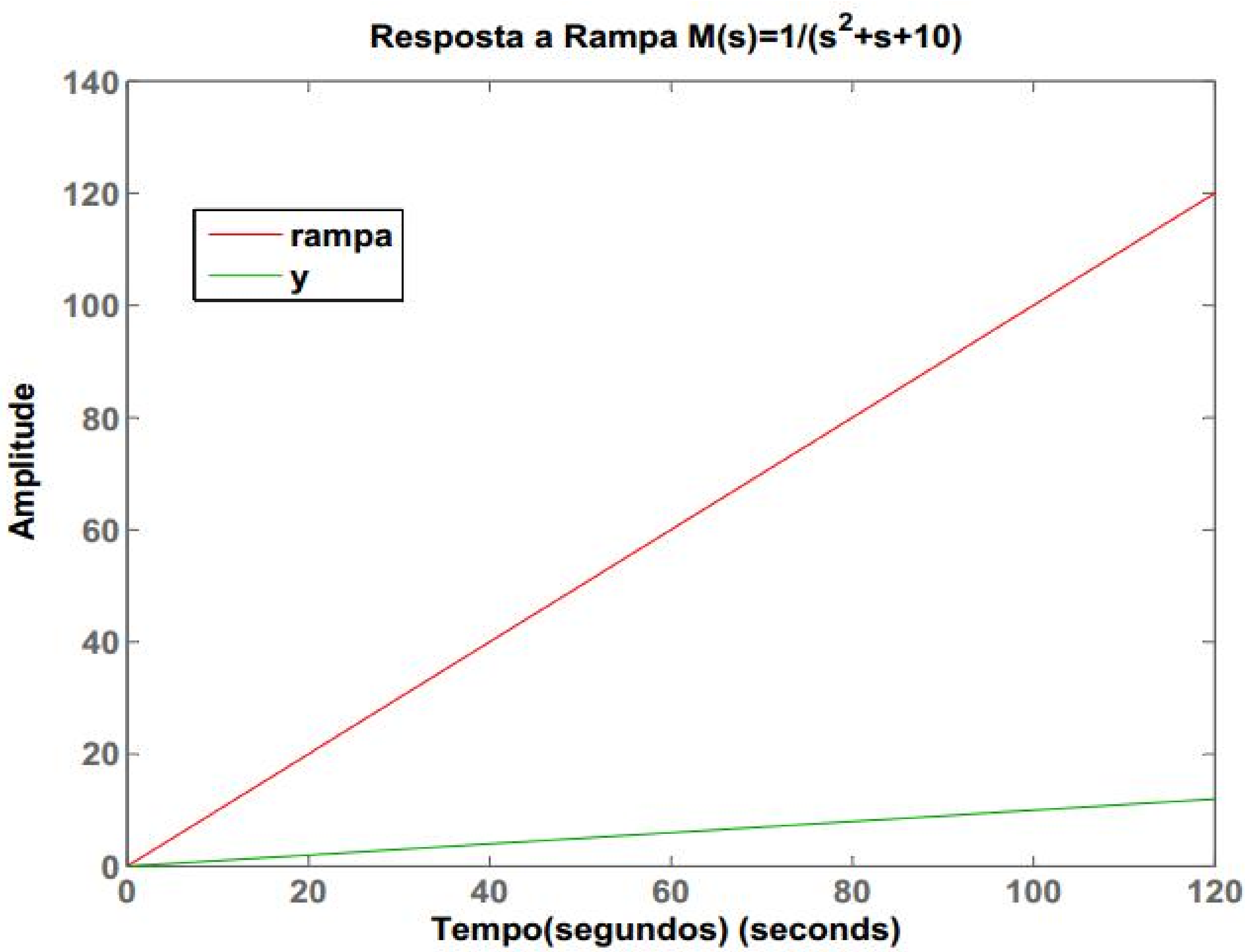
$$\frac{Y(s)}{D(s)} = \frac{1}{s^2 + s + 10} \qquad D(s) = 1/s^2 \quad R(s) = 0$$

$$Ess = \lim_{s\to 0} \frac{- s *G(s)}{1 + G(s)*C(s)} *D(s) \qquad R(s) = 0$$

$$Ess = \lim_{s\to 0} \frac{-s* 1}{s^2 + s + 10} * \frac{1}{s^2}$$

$$Ess = \lim_{s\to 0} \frac{- 1}{s^2 + s + 10} * \frac{1}{s}$$

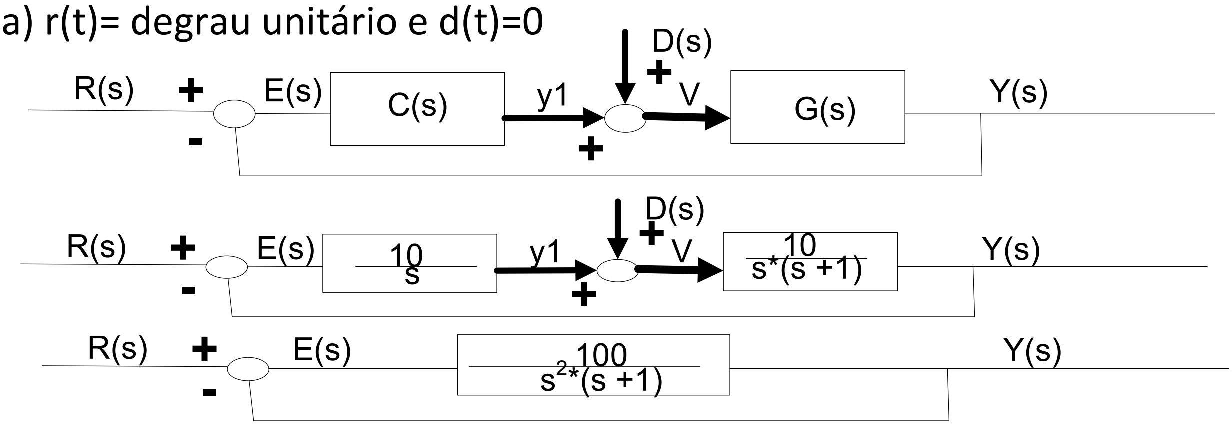
$$Ess = -\infty$$



Item(a)   Refazer para C(s) = 10/s

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

a) r(t)= degrau unitário e d(t)=0



$$\frac{Y(s)}{R(s)} = \frac{C(s)*G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{R(s)} = \frac{100}{s^3 + s^2 + 100} \qquad D(s) = 0 \qquad R(s) = 1/s$$

$$Ess = \lim_{s \to 0} \frac{s * R(s)}{1 + G(s)*C(s)} \qquad D(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{s}{[1 + G(s)*C(s)] * s} \qquad D(s) = 0$$

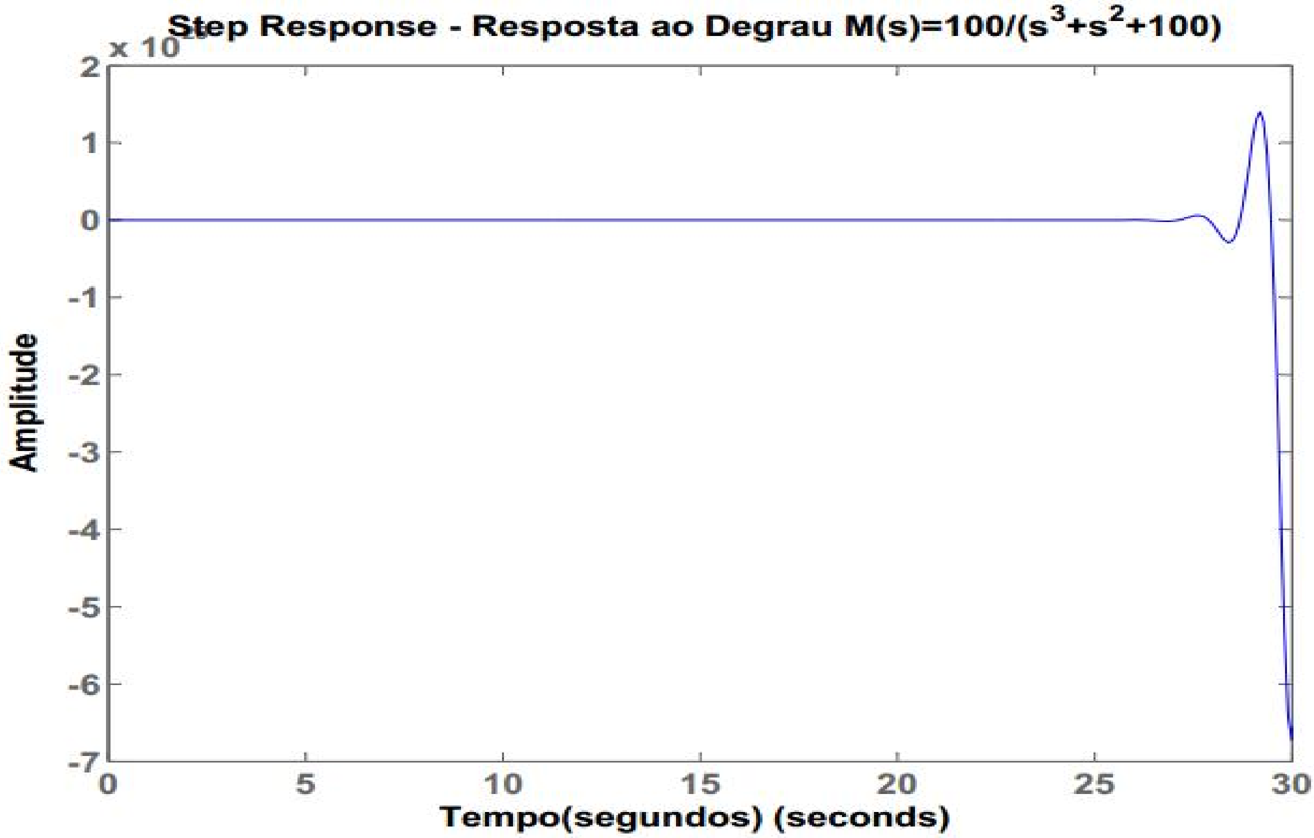
$$Ess = \lim_{s \to 0} \frac{1}{\lim_{s \to 0} [1 + G(s)*C(s)]} = \frac{1}{A}$$

$$A = \lim_{s \to 0} [1 + G(s)*C(s)]$$

$$A = \lim_{s \to 0} 1 + \frac{100}{s^2*(s+1)} = \infty$$

Ess = 0

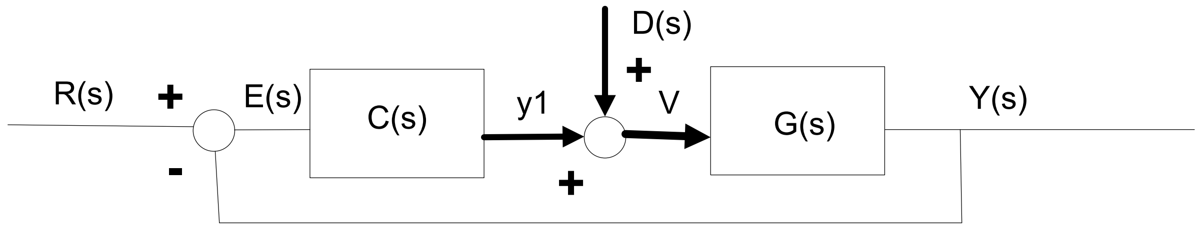
Analise do erro inválida pois Função de transferência tem pólos no semi-plano direito , resposta instável

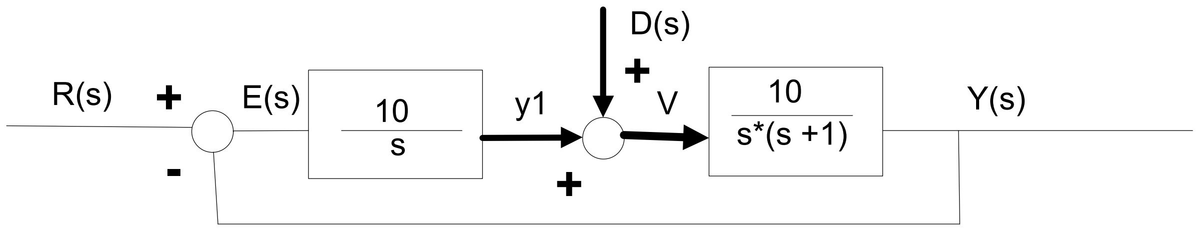


Item(b) Refazer para C(s) = 10/s

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

b) d(t)= degrau unitário e r(t)=0





$$\frac{Y(s)}{D(s)} = \frac{G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{D(s)} = \frac{10*s}{s^3 + s^2 + 100} \qquad D(s) = 1/s \quad R(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{- s *G(s)}{1 + G(s)*C(s)} *D(s) \qquad R(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{-\cancel{s}* 10*s}{s^3 + s^2 + 100} * \frac{1}{\cancel{s}}$$

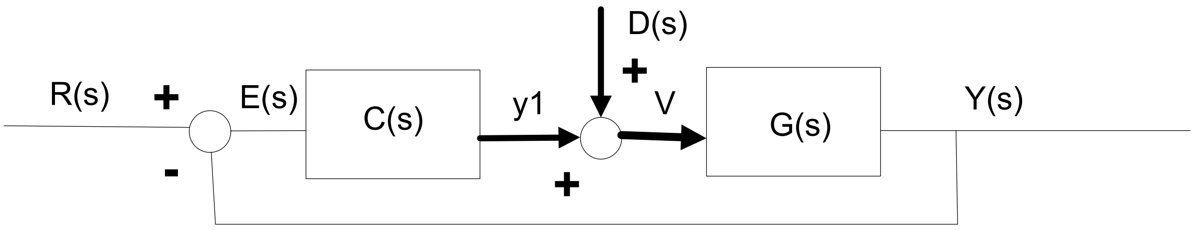
$$Ess = 0$$

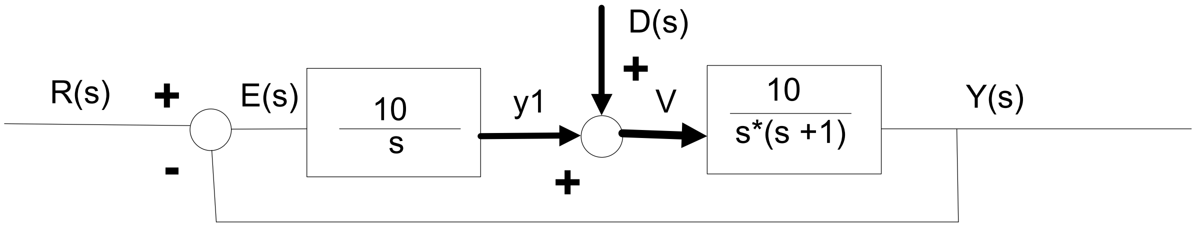
Analise do erro inválida pois Função de transferência tem pólos no semi-plano direito , resposta instável

Item(c) Refazer para C(s) = 10/s

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

c) r(t)= rampa unitária e d(t)=0





$$\frac{Y(s)}{R(s)} = \frac{C(s)*G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{R(s)} = \frac{100}{s^3 + s^2 + 100} \qquad D(s) = 0 \quad R(s) = 1/s^2$$

$$Ess = \lim_{s \to 0} \frac{s *R(s)}{1 + G(s)*C(s)} \qquad D(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{\cancel{s}}{[1 + G(s)*C(s)] * \cancel{s^2}} \qquad D(s) = 0$$

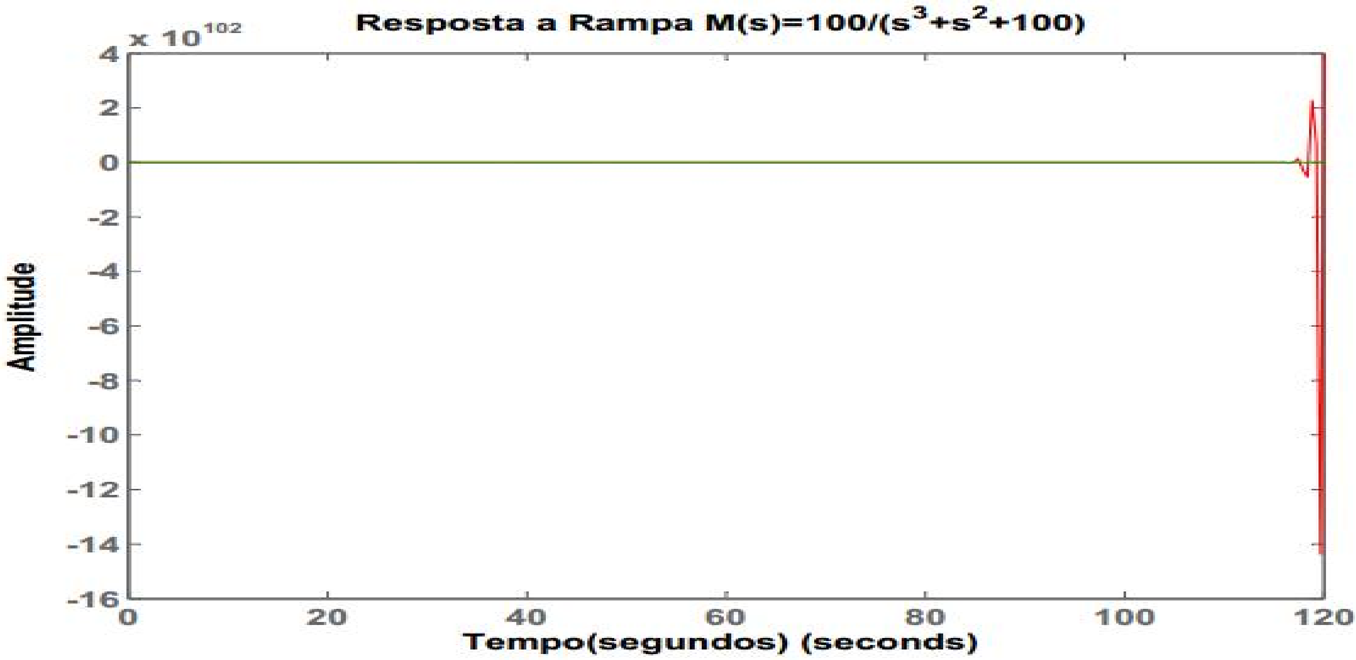
$$Ess = \lim_{s \to 0} \frac{1}{\lim_{s \to 0} [1 + G(s)*C(s)] * s} = \frac{1}{A}$$

$$A = \lim_{s \to 0} [1 + G(s)*C(s)]$$

$$A = \lim_{s \to 0} \left[1 + \frac{100}{\cancel{s^2}*(s+1)} \cancel{*s} \right] = 11$$

$$\lim_{s \to 0} \frac{10}{s*(s+1)} \qquad A = \infty \qquad \boxed{Ess = 0}$$

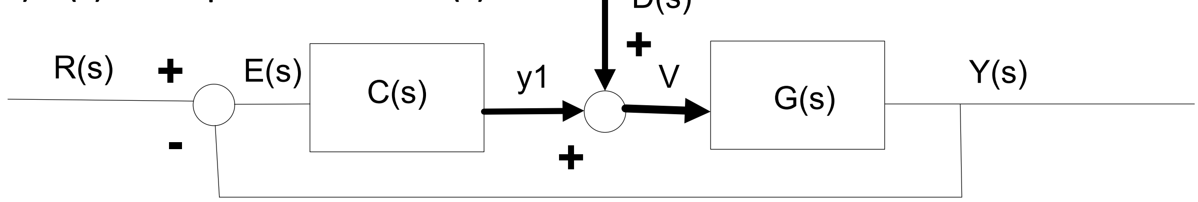
Analise do erro inválida pois Função de transferência tem pólos no semi-plano direito , resposta instável

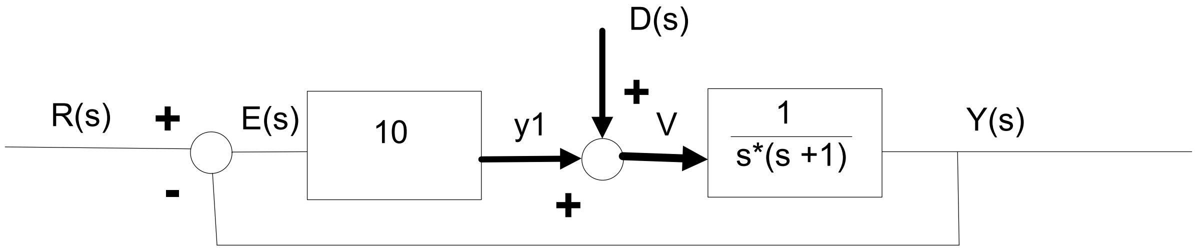


Item(d) Refazer para C(s) = 10/s

$$Y(s) = \frac{C(s)*G(s)}{1 + G(s)*C(s)} *R(s) + \frac{G(s)}{1 + G(s)*C(s)} *D(s)$$

d) d(t)= rampa unitária e r(t)=0





$$\frac{Y(s)}{D(s)} = \frac{G(s)}{1 + G(s)*C(s)}$$

$$\frac{Y(s)}{D(s)} = \frac{10*s}{s^3 + s^2 + 100} \qquad D(s) = 1/s^2 \quad R(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{- s *G(s)}{1 + G(s)*C(s)} *D(s) \qquad R(s) = 0$$

$$Ess = \lim_{s \to 0} \frac{-s* 10*s}{s^3 + s^2 + 100} * \frac{1}{s^2}$$

$$Ess = - 0,1$$

Analise do erro inválida pois Função de transferência tem pólos no semi-plano direito , resposta instável