Transformada de Laplace

$$V_e(s) = R I_1(s) + Ls[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)]$$

$$Ls[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)] = R I_2(s) + R I_2 + \frac{I_2(s)}{Cs}$$

$$V_s(s) = R I_2(s) + \frac{I_2(s)}{Cs} = \frac{CRs + 1}{Cs} I_2(s)$$

Procedimiento algebraico

$$V_e(s) = (R + Ls + R) I_1(s) - (Ls + R) I_2(s)$$

$$= (Ls + 2R) I_1(s) - (Ls + R) I_2(s).$$

$$Ls I_1(s) - Ls I_2(s) + R I_1(s) - R I_2(s) = 2R I_2(s) + \frac{I_2(s)}{Cs}$$

$$Ls I_1(s) + R I_1(s) = 3R I_2(s) + Ls I_2(s) + \frac{I_2(s)}{Cs}$$

$$(Ls + R) I_1(s) = (3R + Ls + 1/Cs) I_2$$

$$I_1(s) = \left[\frac{3R + Ls^2 + 1}{Cs(Ls + R)}\right] I_2 = \frac{CLs^2 + 3CRs + 1}{Cs(Ls + R)} I_2(s)$$

$$V_e(s) = \frac{(Ls + 2R)(CLs^2 + 3CRs + 1)}{Cs(Ls + R)} I_2(s) - (Ls + R) I_2(s)$$

$$= \left[\frac{(Ls + 2R)(CLs^2 + 3CRs + 1) - Cs(Ls + R)(Ls + R)}{Cs(Ls + R)}\right] I_2(s).$$

Multiplicación

$$\cancel{CL^2S^3} + 3CLRS^2 + LS + 2\cancel{CLRS^2} + 6\cancel{CR^2S} + 2R$$
$$LCS(L^2S^2 + 2LRS + R^2) = -\cancel{CL^2S^3} - 2\cancel{CLRS^2} - \cancel{CR^2S}$$

$$Ve(S) = \frac{3CLRS^2 + (5CR^2 + L)S + 2R}{CS(LS + R)} I_2(S)$$

Función de transferencia

$$\frac{Vs(S)}{Ve(S)} = \frac{\frac{CRS + 1}{\cancel{CS}} \cancel{I_2(S)}}{\frac{3CLRS^2 + (5CR^2 + L)S + 2R}{\cancel{CS}(LS + R)} \cancel{I_2(S)}}$$

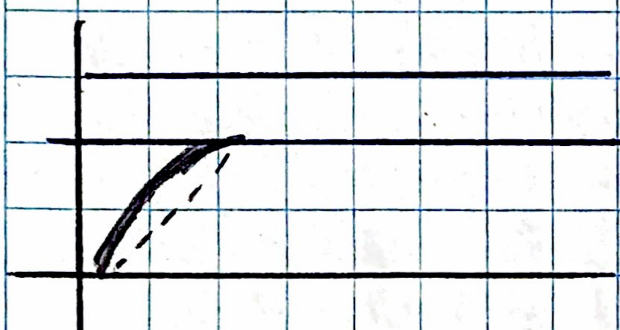
$$\rightarrow (CRS + 1)(LS + R) = CLRS^2 + CR^2S + LS + R$$

$$\frac{Vs(S)}{Ve(S)} = \frac{CLRS^2 + CR^2S + LS + R}{3CLRS^2 + (5CR^2 + L)S + 2R} = \frac{CLRS^2 + (CR^2 + L)S + R}{3CLRS^2 + (5CR^2 + L)S + 2R}$$

Estabilidad en lazo abierto
Calcular los polos de la funcion de transferencia

$$\frac{Vs(s)}{Ve(s)} = \frac{CLRs^2 + (CR^2+L)s + R}{3CLRs^2 + (5CR^2+L) + 2R}$$

El sistema presenta una respuesta estable y sobreamortiguada



$e(t)\} = 1/2 = 0.5V$

$Ve(t) = 1V$

$Ve(s) = 1/s$

$e(t) = 1/2$

Error en estado estacionario

$$e(s) = \lim_{s \to 0} s\, Ve(s) \left[1 - \frac{Vs(s)}{Ve(s)} \right]$$

$$= \lim_{s \to 0} s \cdot \frac{1}{s} \left[1 - \frac{CRLs^2 + (CR^2+L)s + R}{3CLRs^2 + (5CR^2+L)s + 2R} \right]$$

$$= \frac{R}{2R} = \frac{1}{2}$$