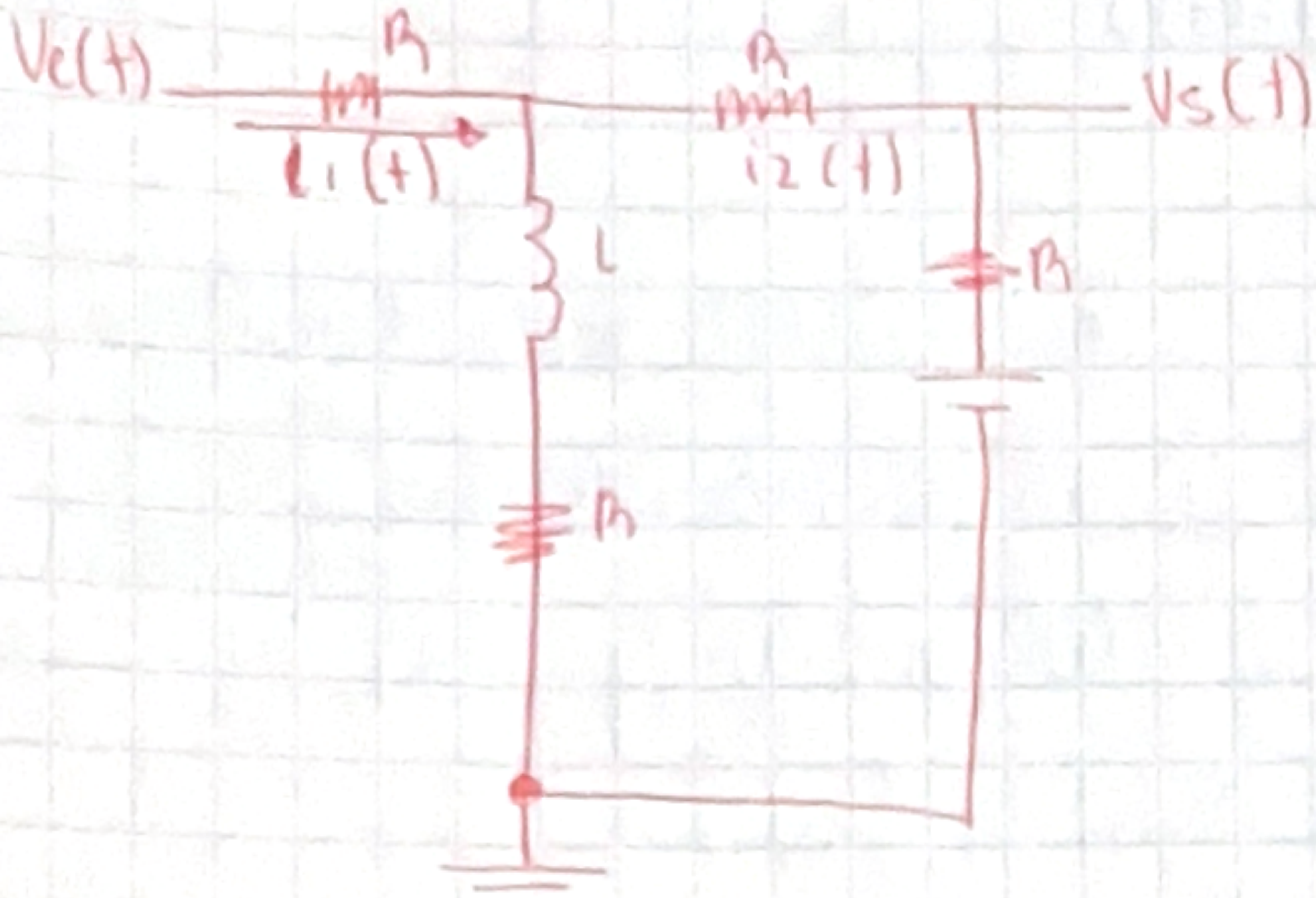
23-Sep 2025

Calculos



• Ecuaciones principales

$$Ve(t) = R i_2(t) + L\frac{d[i_1(t) - i_2(t)]}{dt} + R[i_1(t) - i_2(t)]$$

$$L\frac{d[i_1(t) - i_2(t)]}{dt} + R[i_1(t) - i_2(t)] = R i_2(t) + R i_2(t) + \frac{1}{C}\int i_2(t)\,dt$$

$$Vs(t) = R i_2(t) + \frac{1}{C}\int i_2(t)\,dt$$

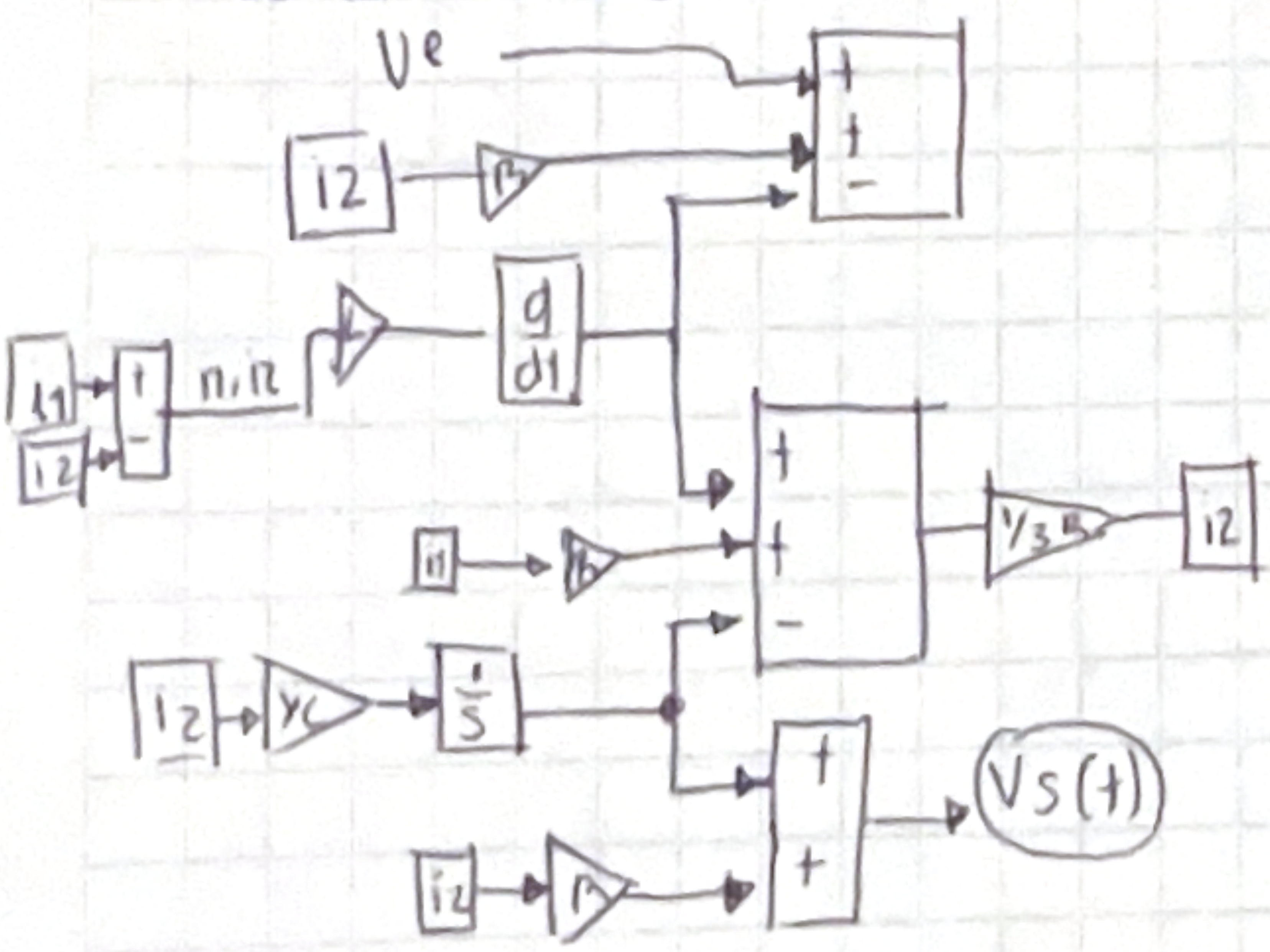
• Modelo de ecuaciones integro-diferenciales.

$$i_1(t) = Ve(t) - L\frac{d[i_1(t) - i_2(t)]}{dt} + R i_2(t)]\frac{1}{2R}$$

$$i_2(t) = [L\frac{d(i_1(t) - i_2(t))}{dt} + R i_1(t) - \frac{1}{C}\int i_2(t)\,dt]\frac{1}{3R}$$

$$Vs(t) = R i_2(t) + 1/C \int i_2(t)\,dt$$

Modelar ecuaciones simulink



• $$Ve(t) = R i_1(t) + L\frac{d[i_1(t) - i_2(t)]}{dt} + R[i_1(t) + i_2(t)]$$

$$L\frac{[i_1(t) - i_2(t)]}{dt} + R[i_1(t) - i_2(t)] = R i_2(t) + \frac{1}{C}\int i_2(t)\,dt$$

26·Sep·2025

- Transformada de Laplace

$Ve(s) = R I_1(s) + LS[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)]$

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

$Vs(s) = R I_2(s) + \frac{I_2(s)}{Cs}$

- Procedimiento algebraico

$Ve(s) = R + LS + R) I_1(s) - (LS + R) I_2(s)$

$= (LS + 2R) I_1(s) - (LS + R) I_2(s)$

$LS I_1(s) - LS I_2(s) + R I_1(s) - R I_2(s) = 2R I_2(s) + \frac{I_2(s)}{CS}$

$LS I_1(s) + R I_1(s) = 3R I_2(s) + LS I_2(s) + \frac{I_2(s)}{CS}$

$(LS + R) I_1(s) = (3R + LS + 1/CS) I_2(s)$

$I_1(s) = \frac{3CRS + CLS^2 + 1}{CS(LS + R)} I_2(s) = \frac{CLS^2 + 3CRS + 1}{CS(LS + R)} I_2(s)$

- Sustitución I_2

$Ve(s) = \frac{(LS + 2R)((L)^2 + 3(RS + 1)}{CS(LS + R)} I_1(s) - (LS + R) I_2(s)$

$= \left[\frac{(LS + 2R)(CLS^2 + 3CR + 1) - CS(LS + R)(LS + R)}{CS(LS + R)}\right] I_2(s)$

$CL^2S^3 + 3CLRS^2 + LS + 2CLRS^2 + 6CR^2S + 2R$

$- CL^2S^3 - 2CLRS^2 - CR^2S$

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

$R = 4.7 k\Omega$

$L = 2.2 mH$

$C = 100 \mu F$

$V(s) = \frac{CRS + 1}{CS} I_2(s)$

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

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

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

num[(100E-6) * (2.2E-3) x (4.7E3), (100E-6) * (4.7E3)^2 + 2.2E-3, 4.7E3]

Modelado 2/Oct/2025

Estabilidad en lazo abierto

- Calcular los polos de la función de transferencia

$$\frac{V_s(s)}{V_e(s)} = \frac{CLRS^2 + (CR^2+L)S + R}{3CLRS^2 + (5CR^2+L)S + 2R}$$

den = [3*C*L*R, 5*C*R**2 + L, 2*R]

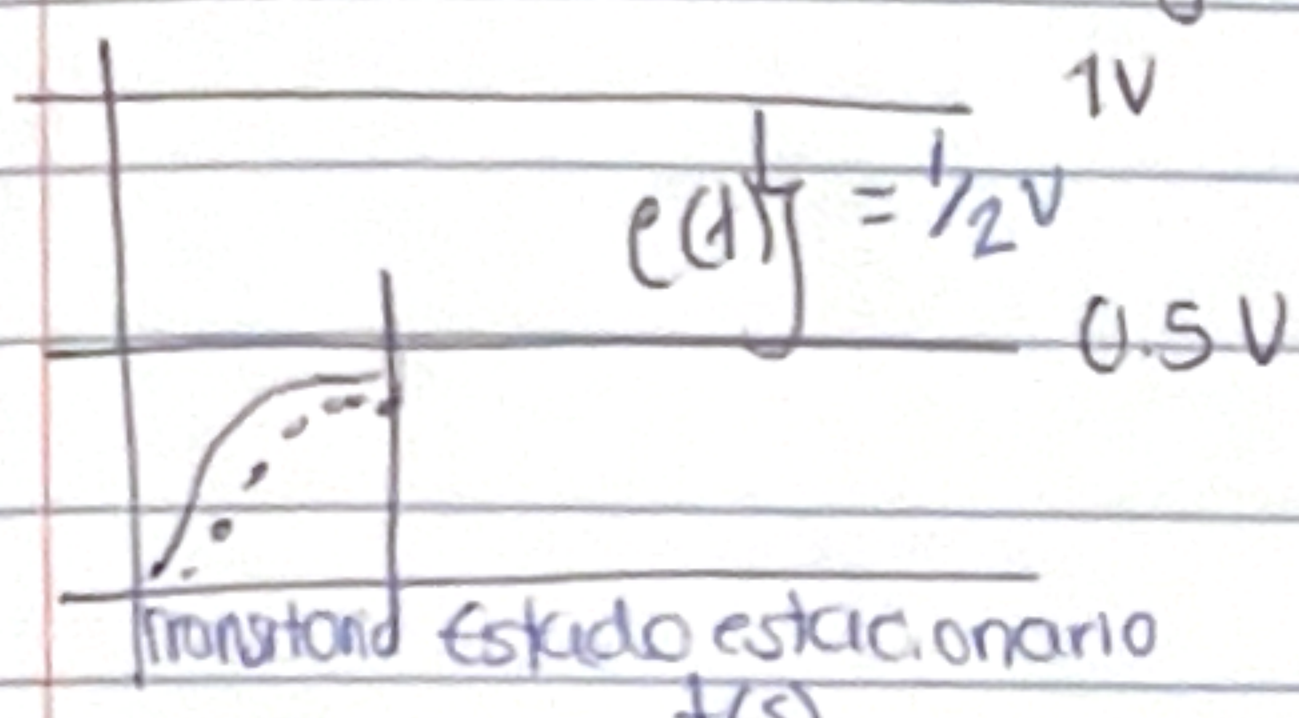
L= np.roots(den)

?

→ fprint : las raíces son: {L[0]} y {L[1]}

El sistema presenta una respuesta:

estable y sobreamortiguada



Error en estado estacionario

$$e(s) = \lim_{s \to 0} s V_e(s) \left[1 - \frac{V_s(s)}{V_e(s)}\right]$$

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

$= R/2R$ $\quad V_e(t) = 1V$

$e(t) = 1/2\ V$ $\quad V_e(s) = 1/s$