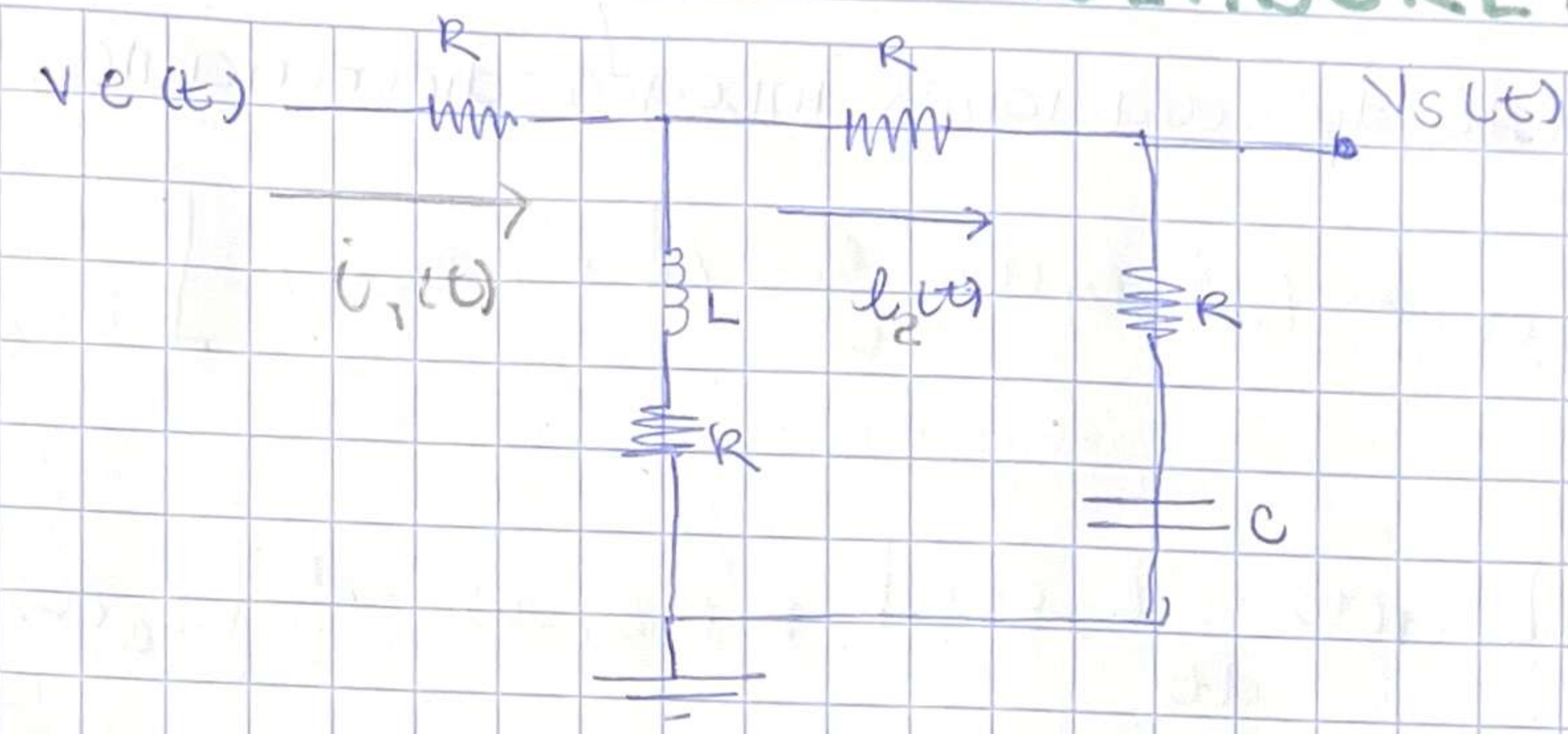
PRÁCTICA 1

DISEÑO DE CONTROLADORES



Ecuaciones principales

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

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

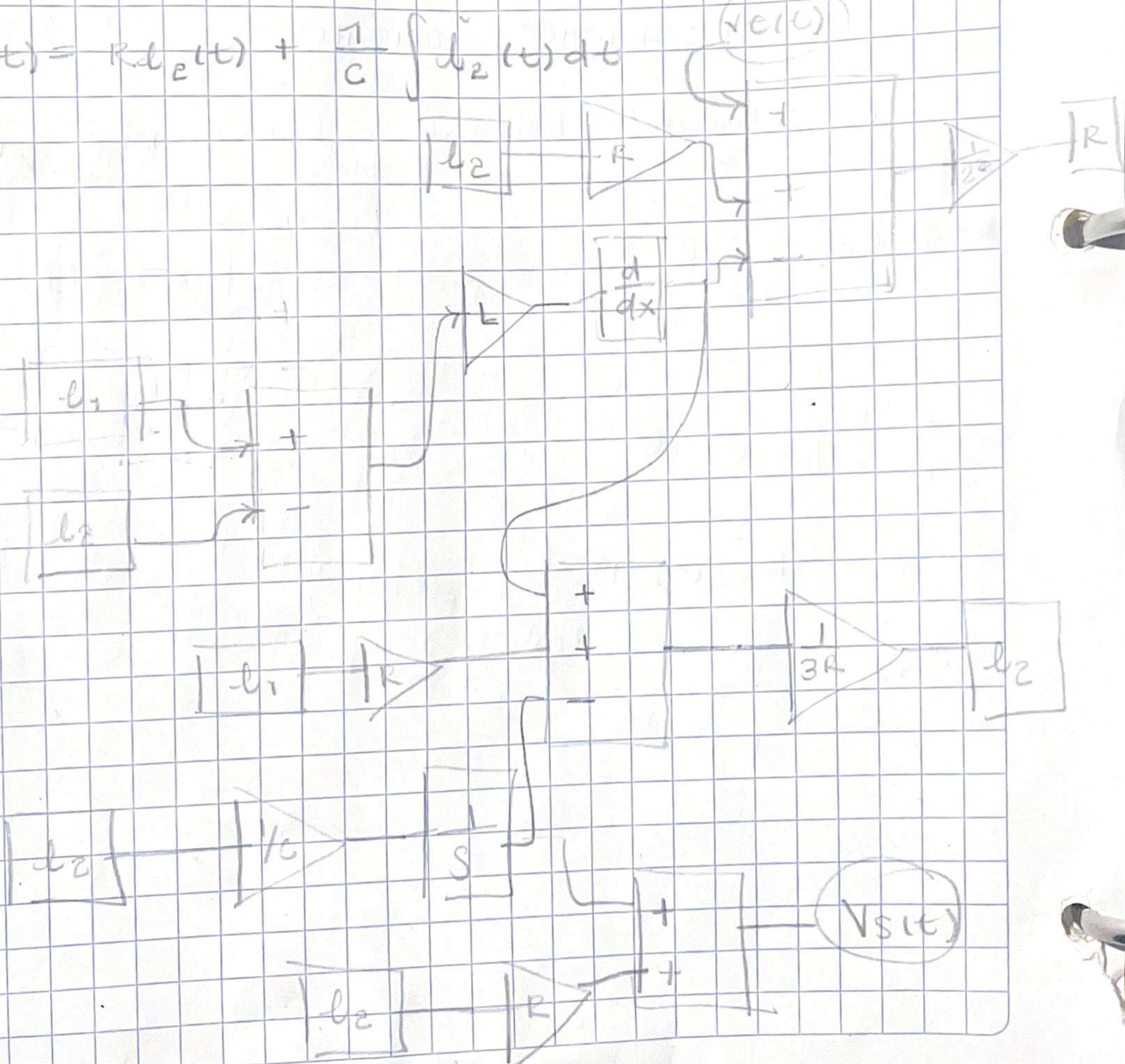
$$Vs(t) = R\,i_2(t) + \frac{1}{C}\int i_2(t)\,dt$$

modulo de ecuaciones integro-diferenciales.

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

$$i_2(t) = \left[L\frac{d[i_1(t) - i_2(t)]}{dt} + R\, i_1(t) - \frac{1}{C}\int i_2(t)\,dt \right] \frac{1}{2R}$$

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



Transformada de Laplace

$$Ve(s) = RI_1(s) + LS[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)]$$

$$LS[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)] = RI_2(s)$$

$$+ RI_2(s) + \frac{I_2(s)}{CS}$$

$$Vs(s) = RI_2(s) + \frac{I_2(s)}{CS} = \boxed{\frac{CRS+1}{CS} \cdot I_2(s)}$$

Procedimiento Algebraico

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

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

$$LSI_1(s) - LSI_2(s) + RI_1(s) - RI_2(s) = 2RI_2(s) + \frac{I_2(s)}{CS}$$

$$LSI_1(s) + RI_1(s) = 3RI_2(s) + LSI_2(s) + \frac{I_2(s)}{CS}$$

$$[LS + R]I_1(s) = \left(3R + LS + \frac{1}{CS}\right)I_2(s)$$

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

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

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

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

$$\cancel{CL^2s^3} + 3CLRs^2 + Ls + \cancel{2CLRs^2} + \overset{5}{\cancel{6}}CR^2s + 2R - \cancel{CL^2s^3} - \cancel{2CLRs^2} - \cancel{CR^2s}$$

$$V_e(s) = \frac{3CLRs^2 + 5CR^2s + L)s + 2R}{Cs(Ls + R)}$$

$$V_e(s) = \frac{\dfrac{CRs + 1}{\cancel{Cs}} \cancel{I_2(s)}}{\dfrac{3CLRs^2 + (5CR^2 + L)s + 2R}{\cancel{Cs}(Ls + R)} \cancel{I_2(s)}}$$

$$(CRs + 1)(Ls + R) - CLRs^2 + CR^2s + Ls + R$$

$R = 9 \times 10^3$ $\quad$ $C = 22 \times 10^{-6}$ $\quad$ $L = 33 \times 10^{-3}$

Estabilidad en lazo abierto

Calcular los polos de la función de transferencia

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

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

L = np.roots (den

fprint: Las raices son {L[0]} y {L[1]}
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El sistema presenta una respuesta estable y sobreamortiguada.

$V_e(t) = 1\,V$

$V_e(t) = \frac{1}{s}$

Error en estado transitorio

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

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

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

$$e(t) = \frac{1}{2} V$$