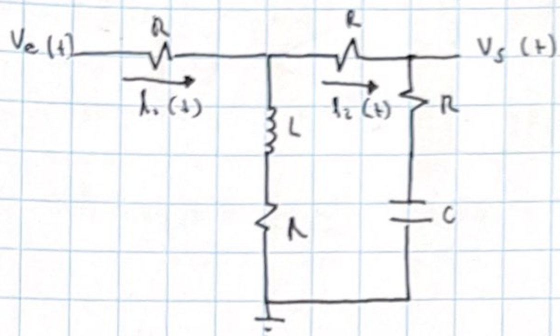
Modelado de sistemas fisiologicos 23/09/25

Practica 1

Analisis



Ecuaciones principales

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

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

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

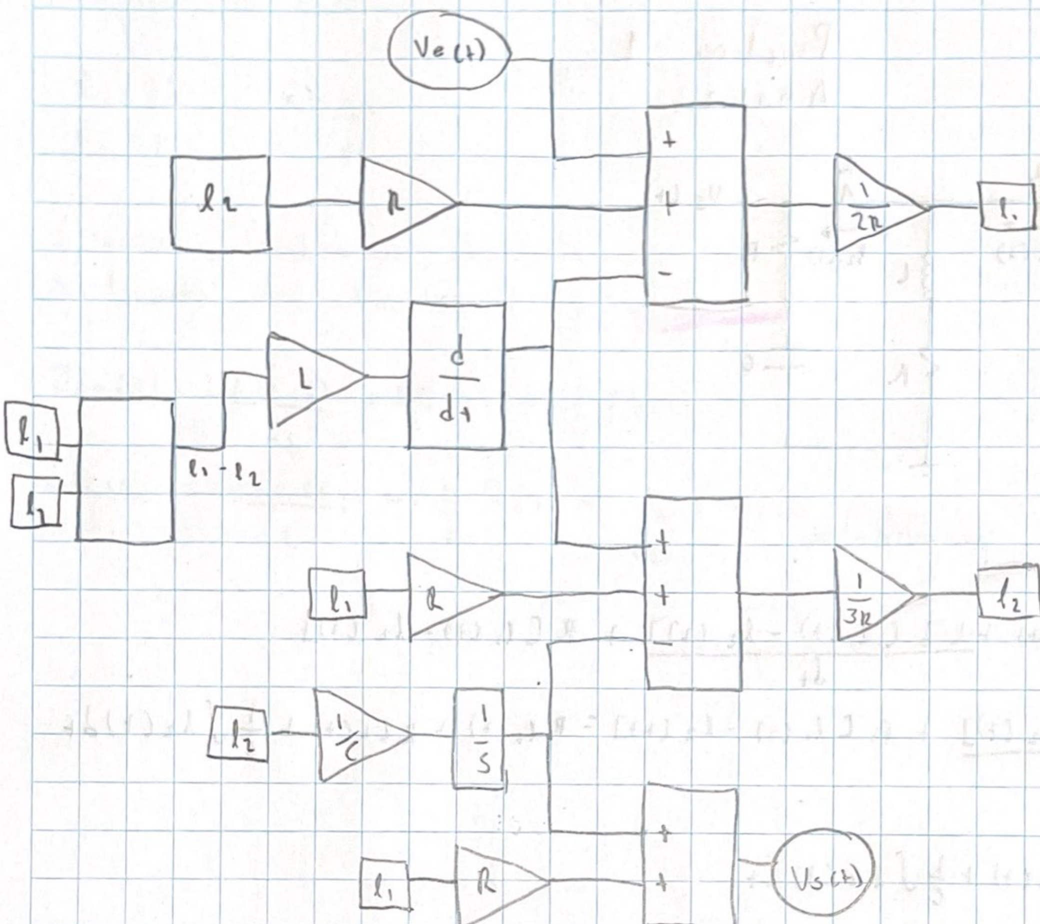
Modelo de ecuaciones integro-diferenciales

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

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

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

Modelado de sistemas fisiológicos



Transformada de Laplace

$$L s I_1(s) - L s I_2(s) + R I_1(s) - R I_2(s)$$

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

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

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

Procedimiento algebraico

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

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

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

$$(Ls + R) I_1(s) = \left(3R + Ls + \frac{1}{Cs}\right) I_2(s)$$

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

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

$$V_e(s) = \frac{(Ls + 2R)(CLs^2 + 3CRs + 1)}{Cs(Ls + R)} I_1(s) - (Ls + R) I_2(s)$$

$$L^2 s^2 + 2LRs + R^2$$

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

Modelado de sistemas fisiologicos 26/04/25

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

$$-\cancel{CL^2s^2} - \cancel{2CLRs^2} - CR^2s \qquad 5CR^2s$$

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

$$Vs(s) = \frac{\frac{CRs+1}{Cs}\,\cancel{I_2(s)}}{\frac{3CLRs^2 + s(R^2+L)s + 2R}{Cs(Ls+R)}\,\cancel{I_2(s)}}$$

$CCRs$

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

Modelado de sistemas fisiologicos 02/10/25

Estabilidad en lazo abierto

• Calcular los polos de la función de transferencia

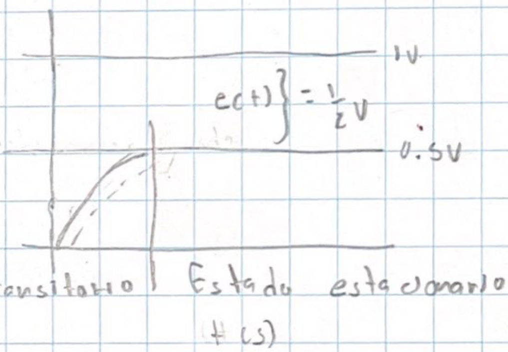
$$\frac{V_s(s)}{V_e(s)} = \frac{CLRs^2 + (CR^2+L)s + R}{3CLRs^2 + (5CR^2+L)s + 2R}$$

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

L = np.roots(den)
f print: Las raíces son {L[0]} y {L[1]}

$\lambda_1 = -454545.117$
$\lambda_2 = -2.020$

Presenta una respuesta estable y sobreamortiguada.



Error en estado estacionario

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

$V_e(t) = 1\,V$

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

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

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

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