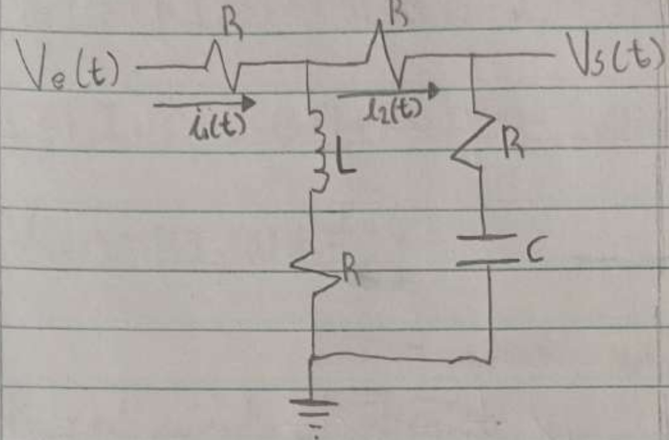
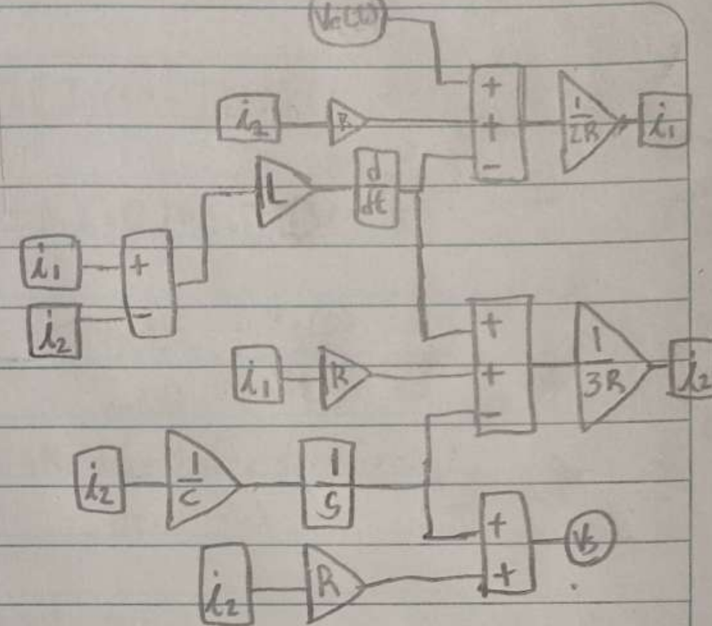
Practica 1:





Ecuaciones principales.

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

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

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

Modelo de ecuaciones integro-diferenciales

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

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

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

Transformada de Laplace

$$V_e(s) = RI_1(s) + Ls[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)]$$

$$Ls[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)] = RI_2(s) + RI_2(s) + \frac{I_2(s)}{Cs}$$

$$V_s(s) = RI_2(s) + \frac{I_2(s)}{Cs}$$

$$\frac{V_s(s)}{V_e(s)} = \frac{?\ I_2(s)}{?\ I_2(s)}$$

Nota ¡No debe haber terminos negativos

Procedimiento algebraico

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

$$LsI_1(s) - LsI_2(s) + RI_1(s) - RI_2(s) = 2RI_2(s) + \frac{I_2(s)}{Cs}$$

$$LsI_1(s) + RI_1(s) = 3RI_2(s) + LsI_2 + \frac{I_2(s)}{Cs}$$

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

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

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

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

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

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

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

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

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

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

Estabilidad en Lazo abierto

Calcular los polos de la funcion de transferencia

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

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

L = np.roots(den)

print(f"Las raices son: {L[0]} y {L[1]}")
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-24509803.25490185 y -4.000001088000205

Error en estado ~~estable~~ estacionario

$V_e(t) = 1V$

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

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

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

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

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

El sistema presenta respuesta estable y sobreamortiguada