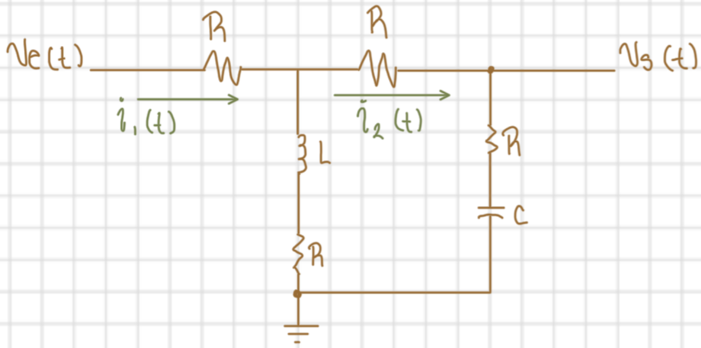
Práctica 1.

23-septiembre-2025



Ecuaciones principales

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

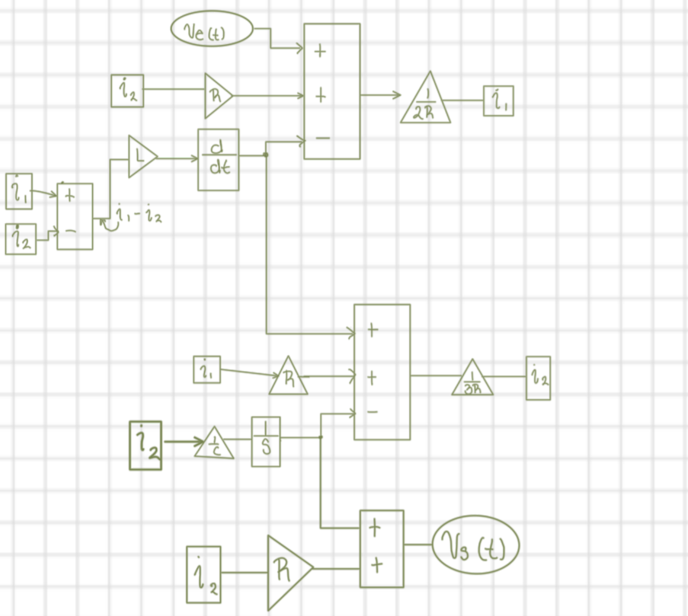
$$\frac{L\,d[i_1(t)-i_2(t)]}{dt} + R[i_1(t)-i_2(t)]$$

Modelo de ecuaciones integro diferenciales

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

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

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



Transformada de Laplace

$R=$

$$LS\,i_1(s) - LS\,i_2(s) + R\,i_1(s) - R\,i_2(s)$$

$$Ve(s) = R\,i_1(s) + Ls[i_1(s) - i_2(s)] + R[i_1(s) - i_2(s)]$$

$$LS[i_1(s) - i_2(s)] + R[i_1(s) - i_2(s)] = R\,i_2(s) + R\,i_2(s) + \frac{i_2(s)}{CS}$$

$$Vs(s) = R\,i_2(s) + \frac{i_2(s)}{Cs}$$

Procedimiento algebraico

No debe de haber términos negativos !!!

$$Ve(s) = (R + LS + R)\,i_1(s) - (Ls + R)\,i_2(s)$$

$$= (LS + 2R)\,i_1(s) - (LS + R)\,i_2(s)$$

$$LS\,i_1(s) - LS\,i_2(s) + R\,i_1(s) - R\,i_2(s) = 2R\,i_2(s) + \frac{i_2(s)}{Cs}$$

$$Ls\,i_1(s) + R\,i_1(s) = 3R\,i_2(s) + LS\,i_2(s) + \frac{i_2(s)}{Cs}$$

$$(Ls+R)\,i_1(s) = \left(3R + Ls + \frac{1}{Cs}\right) i_2(s)$$

$$i_1(s) = \frac{3CRS + CLS^2 + 1}{CS + (LS+R)} \quad i_2(s) = \frac{CLS^2 + 3CRS + 1}{Cs(LS+R)}\, i_2(s)$$

$$Ve(s) = \frac{(LS+2R)(CLS^2 + 3CRS + 1)}{CS(LS+R)}\, i_2(s) - (Ls + R)\, i_2(s)$$

$$= \left[\frac{(LS+2R)(CLS^2 + 3(R+1)) - CS(LS+R)(LS+R)}{CS(LS+R)}\right] i_2(s)$$

$$\cancel{CL^2S^3} + 3CLRS^2 + LS + \cancel{2CLRS^2} + 6CR^2S + 2R$$

$$-\cancel{CL^2S^3} - \cancel{2CLRS^2} - CR^2S \quad 5CR^2S$$

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

$$Vs(s) = \frac{\frac{CRS+1}{CS}\, i_2(s)}{\frac{3CLRS^2 + (5CR^2 + L)S + 2R}{CS(LS+R)}\, i_2(s)}$$

$$\frac{Vs(s)}{Ve(s)} = \frac{CLRS^2 + (CR^2 + L)S + R}{3CLRS^2 + (5CR^2 + 1)S + 2R}$$

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)
fpoint: Los raíces son {L[0]} y {L[1]}
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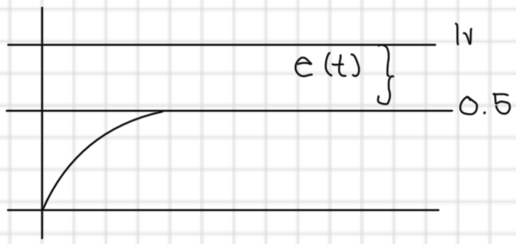
$\lambda_1 = -106382.911$

$\lambda_2 = -0.404$

$\therefore$

El sistema presenta una respuesta estable y sobreamortiguada



Error en estado estacionario

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

$$= \lim_{s\to 0} s \cdot \frac{1}{s}\left[1 - \frac{CLR0^2 + (CR^2+L)s + R}{3CLRs^2 + (5CR^2+L)s + 2R}\right]$$

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

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