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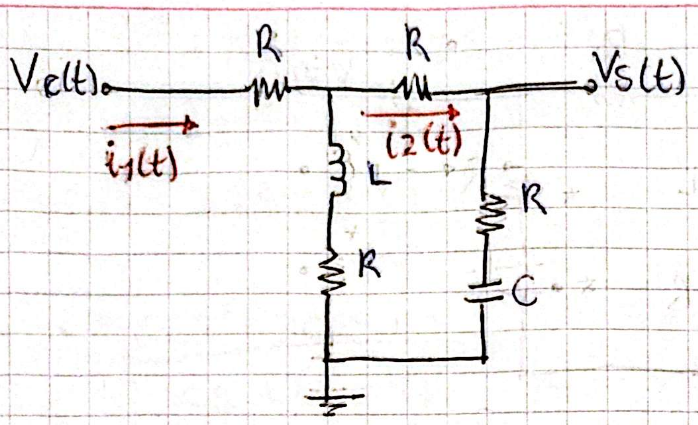


simulink

$R = 3k\Omega$
$C = 330\mu F$
$L = 47mH$

→ Ecuaciones principales

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

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

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

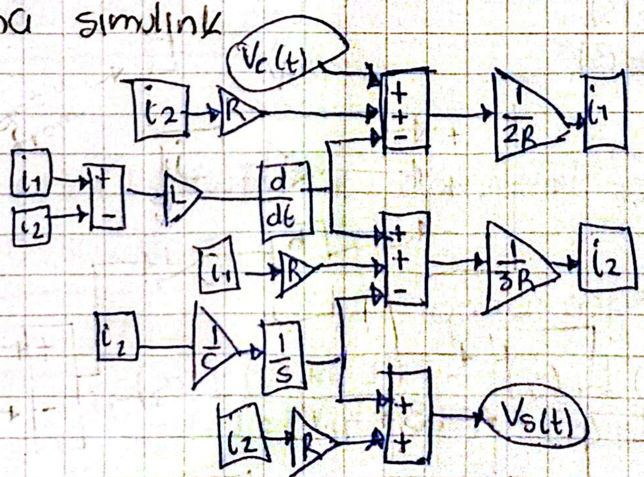
→ Modelo de ecuaciones integrodiferenciales

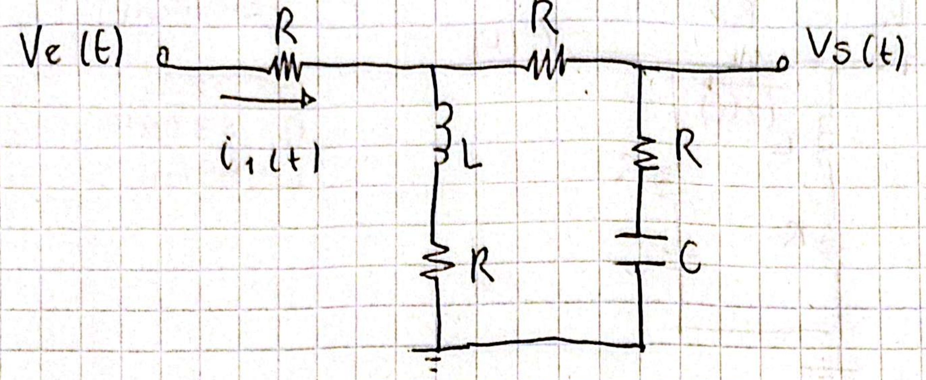
$$i_1(t) = \left[V_e(t) - L\frac{d[i_1(t) - i_2(t)]}{dt} + R i_2(t)\right]\frac{1}{2R}$$

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

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

→ Diagrama simulink





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

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

$$V_s(t) = \frac{1}{C}\int I_2(t)\,dt + R\, i_2(t)$$

→ Transformada de Laplace

$$V_e(s) = R\, I_1(s) + LS[I_1(s) - I_2(s)] + R[I_1(s) - I_2(s)]$$

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

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

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

Nota: No debe haber términos negativos

→ Procedimiento algebraico

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

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

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

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

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

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

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

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

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

$$5CR^2S$$

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

$$V_S(S) = \frac{\dfrac{CRS+1}{\cancel{CS}} \cancel{I_2(S)}}{\dfrac{3CLRS^2 + (5CR^2+L)S + 2R}{\cancel{CS}(LS+R)} * \cancel{I_2(S)}}$$

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

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

función de transferencia

→ Estabilidad en lazo abierto

• Calcular los polos de la funcion de transferencia

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

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

L = np.roots (den)

→ f print: las raices son {L[0]} y {L[1]}

$\lambda_1 = -106382.911$
$\lambda_2 = -0.404$

El sistema presenta una respuesta estable y sobreamortiguada.

Error en estado estacionario

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

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

$Ve(t) = 1v$
$Ve(s) = \frac{1}{s}$

$$e(s) = \frac{R}{2R}$$

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