## Ecuaciones Principales

1 $$P_e(t) = L\frac{di_1(t)}{dt} + R_1(i_1) + \frac{1}{C}\int i_1(t) - i_2(t)\, dt$$

2 $$\frac{1}{C}\int i_1(t) - i_2(t)\, dt = R_2(i_2)$$

3 $$P_s(t) = R_2(i_2)$$

## Procedimiento...

$$P_e(s) = LS\, I_1(s) + R_1 I_1(s) + \frac{I_1(s) - I_2(s)}{CS}$$

$$\frac{I_1(s) - I_2(s)}{CS} = R_2 I_2(s)$$

$$P_s(s) = R_2 I_2(s)$$

$$P_{e(s)} = \left[LS + R_1 + \frac{1}{CS}\right] I_1(s) - \frac{I_2(s)}{CS}$$

$$\frac{I_1(s)}{CS} = R_2 I_2(s) + \frac{I_2(s)}{CS}$$

$$\frac{I_1(s)}{CS} = \left[R_2 + \frac{1}{CS}\right] I_2(s)$$

$$I_1(s) = [CSR_2 + 1]\, I_2(s)$$

$$P_e(s) = \left[LS + R_1 + \frac{1}{CS}\right][CSR_2 + 1]\, I_2(s) - \frac{I_2(s)}{CS}$$

$$P_e(s) = \left[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2 + \frac{1}{CS}\right] I_2(s) - \frac{1}{CS} I_2(s)$$

$$P_e(s) = \left[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2 + \cancel{\frac{1}{CS}} - \cancel{\frac{1}{CS}}\right] I_2(s)$$

Función de transferencia.

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2 \cancel{I_2(s)}}{[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2]\, \cancel{I_2(s)}}$$

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2}{[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2]}$$

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2}{CLR_2s^2 + (L + CR_2R_1)S + R_1 + R_2}$$

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$$P_e(s) = \left[LS + R_1 + \frac{1}{CS}\right][CSR_2 + 1]\, I_2(s) - \frac{I_2(s)}{CS}$$

$$P_e(s) = \left[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2 + \frac{1}{CS}\right] I_2(s) - \frac{1}{CS} I_2(s)$$

$$P_e(s) = \left[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2 + \cancel{\frac{1}{CS}} - \frac{1}{CS}\right] I_2(s)$$

Función de transferencia.

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2 I_{\cancel{2}}(s)}{[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2]\, I_{\cancel{2}}(s)}$$

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2}{[CLR_2s^2 + LS + CR_1R_2S + R_1 + R_2]}$$

$$\frac{P_s(s)}{P_e(s)} = \frac{R_2}{CLR_2s^2 + (L + CR_2R_1)S + R_1 + R_2}$$

Valores para control

$L = 0.5\,H$
$R_1 = 1\,\Omega$
$C = 2\,F$
$R_2 = 0.5\,\Omega$

Valores para caso

$L = 0.5\,H$
$R_1 = 1.5\,\Omega$
$C = 0.8\,F$
$R_2 = 0.75\,\Omega$

Estabilidad en lazo abierto

$$\lambda = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$P_{e(s)} = CLR_2 s^2 + (L + CR_2R_1)s + (R_1 + R_2)$$

$a = CLR_2$
$b = L + CR_2R_1$
$c = R_1 + R_2$

$$\lambda = \frac{-(L + CR_2R_1) \pm \sqrt{(L + CR_2R_1)^2 - 4(CLR_2)(R_1 + R_2)}}{2(CLR_2)}$$

$$\lambda = \frac{-(1.5) \pm \sqrt{(2.25) - 4(0.5)(1.5)}}{2(0.5)}$$

$\lambda_1 = -1.5 + 0.866i$
$\lambda_2 = -1.5 - 0.866i$ } Raices complejas conjugadas

El sistema es estable con una respuesta subamortiguada.

Error en estado estacionario

$$e(s) = \lim_{s \to 0} s \cdot \frac{1}{s}\left(1 - \frac{R_2}{\cancel{CLR_2 s^2}_{\to 0} + \cancel{(L + CR_2R_1)S}_{\to 0} + R_1 + R_2}\right)$$

$$e(s) = \lim_{s \to 0} \cancel{s} \cdot \frac{1}{\cancel{s}}\left(1 - \frac{R_2}{R_1 + R_2}\right) = 1 - \frac{0.5}{1 + 0.5} = 0.6667$$

# Ecuaciones integro-diferenciales

de las ecuaciones principales

1. $P_e(t) = L\frac{di_1(t)}{dt} + R_1(i_1) + \frac{1}{C}\int i_1(t) - i_2(t)\, dt$

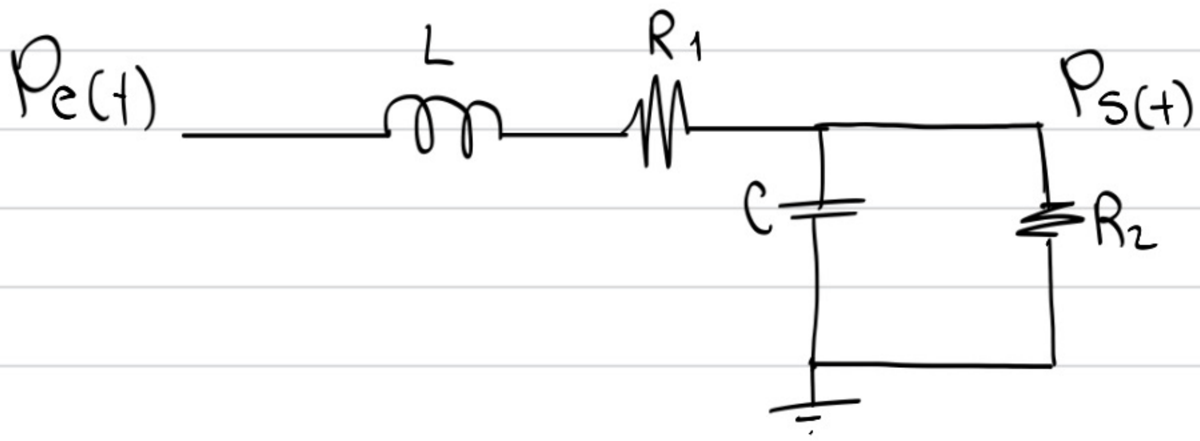
2. $\frac{1}{C}\int i_1(t) - i_2(t)\, dt = R_2(i_2)$

3. $P_s(t) = R_2(i_2)$

$$I_1(t) = \left[P_e(t) - L\frac{dI_1(t)}{dt} - \frac{1}{C}\int I_1(t) - I_2(t)\,dt\right]\frac{1}{R_1}$$

$$I_2(t) = \left[\frac{1}{C}\int I_1(t) - I_2(t)\,dt\right]\frac{1}{R_2}$$

$$P_S(t) = R_2 I_2(t)$$

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