Ecuaciones principales.

$$I_T(t) = I_C(t) + I_{R_2}(t)$$

$$I_C(t) = C \cdot \frac{dV_0(t)}{dt} \qquad I_{R_2}(t) = \frac{V_0(t)}{R_2}$$

$$V_{in}(t) - V_0(t) = L\frac{dI_T(t)}{dt} + R_1 I_T(t)$$

Transformada de laplace

$$V_{in}(s) - V_0(s) = LS\, I_T(s) + R_1 I_T(s)$$
$$V_{in}(s) - V_0(s) = I_T(s)[LS + R_1]$$
$$\frac{V_{in}(s) - V_0(s)}{LS + R_1} = I_T(s)$$

$$I_C(s) = CS\, V_0(s) \qquad I_{R_2}(s) = \frac{V_0(s)}{R_2}$$

$$\frac{V_{in}(s) - V_0(s)}{LS + R_1} = CS\, V_0(s) + \frac{V_0(s)}{R_2}$$

$$\frac{V_{in}(s)}{LS + R_1} - \frac{V_0(s)}{LS + R_1} = CS\, V_0(s) + \frac{V_0(s)}{R_2}$$

$$\frac{V_{in}(s)}{LS + R_1} = \frac{V_0(s)}{LS + R_1} + CS\,V_0(s) + \frac{V_0(s)}{R_2}$$

$$\frac{V_{in}(s)}{LS + R_1} = V_0(s)\left[\frac{1}{LS + R_1} + Cs + \frac{1}{R_2}\right]$$

$$\frac{V_{in}(s)}{V_0(s)} = LS + R_1\left[\frac{1}{LS + R_1} + Cs + \frac{1}{R_2}\right]$$

Función de transferencia: $\dfrac{V_0(s)}{V_{in}(s)}$

$$\frac{V_0(s)}{V_{in}(s)} = \frac{\frac{1}{LS + R_1}}{\frac{1}{LS + R_1} + Cs + \frac{1}{R_2}} = \frac{\frac{1}{LS + R_1}}{\frac{R_2 + CS[R_2(LS+R_1)] + (LS+R_1)}{R_2(LS+R_1)}}$$

$$\frac{V_0(s)}{V_{in}(s)} = \frac{R_2(LS+R_1)}{(LS+R_1)(R_2 + CS[R_2(LS+R_1)] + (LS+R_1))}$$

$$\frac{V_0(s)}{V_{in}(s)} = \frac{R_2}{R_2 + (R_2LCS^2 + CR_1R_2 S) + (LS + R_1)}$$

$$\frac{V_0(s)}{V_{in}(s)} = \frac{R_2}{(R_2LC)S^2 + (L + CR_1R_2)S + (R_1 + R_2)}$$

Error en estado estacionario

$$e(s) = \lim_{s \to 0} s\,V_{in}(s)\left[1 - \frac{V_0(s)}{V_{in}(s)}\right]$$

$$= \lim_{s \to 0} \cancel{s}\frac{1}{\cancel{s}}\left[1 - \frac{R_2}{(R_2LC)S^2 + (L + CR_1R_2)S + (R_1 + R_2)}\right]$$

$$= \left[1 - \frac{R_2}{R_1 + R_2}\right]$$

Modelo de ecuaciones integro-diferenciales.

$$I_T(t) = I_C(t) + I_{R_2}(t)$$

$$I_C(t) = C \cdot \frac{dV_o(t)}{dt} \qquad I_{R_2}(t) = \frac{V_o(t)}{R_2}$$

$$V_{in}(t) - V_o(t) = L\frac{dI_T(t)}{dt} + R_1 I_T(t)$$

$$V_o(t) = \frac{1}{C}\int I_C(t)\,dt \rightarrow V_o(t) = \frac{1}{C}\int \left(I_T(t) - \frac{V_o(t)}{R_2}\right)dt$$

$$I_T(t) = \left[V_{in}(t) - V_o(t) - L\frac{dI_T(t)}{dt}\right]\frac{1}{R_1}$$

Estabilidad de lazo abierto de control.
Raices $\qquad\qquad R_1 = 1K\Omega \; ; \; R_2 = 0.8K \; ; C = 0.02F \; ; \; L = 0.1 H.$

$a = R_2 LC \qquad\qquad = 1.6$

$b = L + CR_1R_2 \qquad = 16.0001 \times 10^3$

$C = R_1 + R_2 \qquad\quad = 1800$

$X_1 = -0.1125 \qquad\qquad$ Estable con respuesta

$X_2 = -9999.999 \qquad\quad$ sobreamortiguada.

Estabilidad de lazo abierto de caso
Raices $\qquad\qquad R_1 = 5K\Omega \; ; R_2 = 2K \; ; C = 0.15 F \; ; C = 0.008H$

$a = R_2 LC \qquad\qquad = 2.4$

$b = L + CR_1R_2 \qquad = 80,000.15$

$C = R_1 + R_2 \qquad\quad = 7000$

$X_1 = -0.0875 \qquad\qquad$ Estable con respuesta

$X_2 = -33,333.3083 \qquad$ sobreamortiguada.