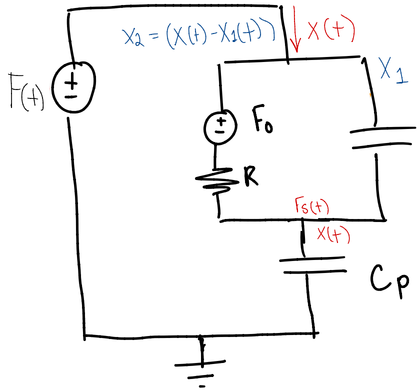
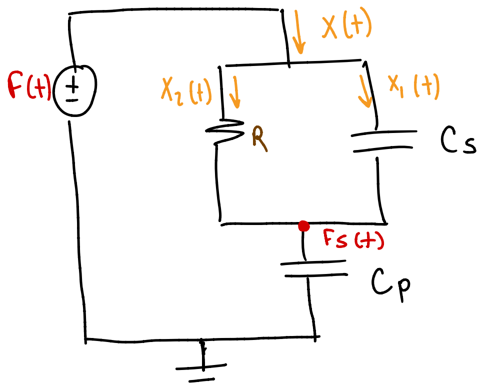
derivada en capacitores

Sistema musculoesquelético

Circuito eléctrico



Función de transferencia – Análisis por superposición



Análisis por nodos

$$x(t) = x_1(t) + x_2(t)$$

$$X(t) = C_p \frac{d\left(F_s(t) - 0\right)}{dt}$$

$$X_1(t) = C_s \frac{d\left[F(t) - F_s(t)\right]}{dt}$$

$$X_2(t) = \frac{F(t) - F_s(t)}{R}$$

$$C_p \frac{dF_s(t)}{dt} = C_s \frac{d\left[F(t) - F_s(t)\right]}{dt} + \frac{F(t) - F_s(t)}{R}$$

Transromada de Laplace

$$C_p s F_s(s) = C_s s\,[F_s - F_s(s)] + \frac{F_s - F_s(s)}{R}$$

$$C_p s F_s(s) = C_s s F_s - C_s s F_s(s) + \frac{F_s}{R} - \frac{F_s(s)}{R}$$

$$\left(C_p s + C_s s + \frac{1}{R}\right) F_s(s) = \left(C_s s + \frac{1}{R}\right) F(s)$$

$$C_p \frac{R_s + C_s R_s + 1}{R} F_s(s) = \frac{C_s R_s + 1}{R} F(s)$$

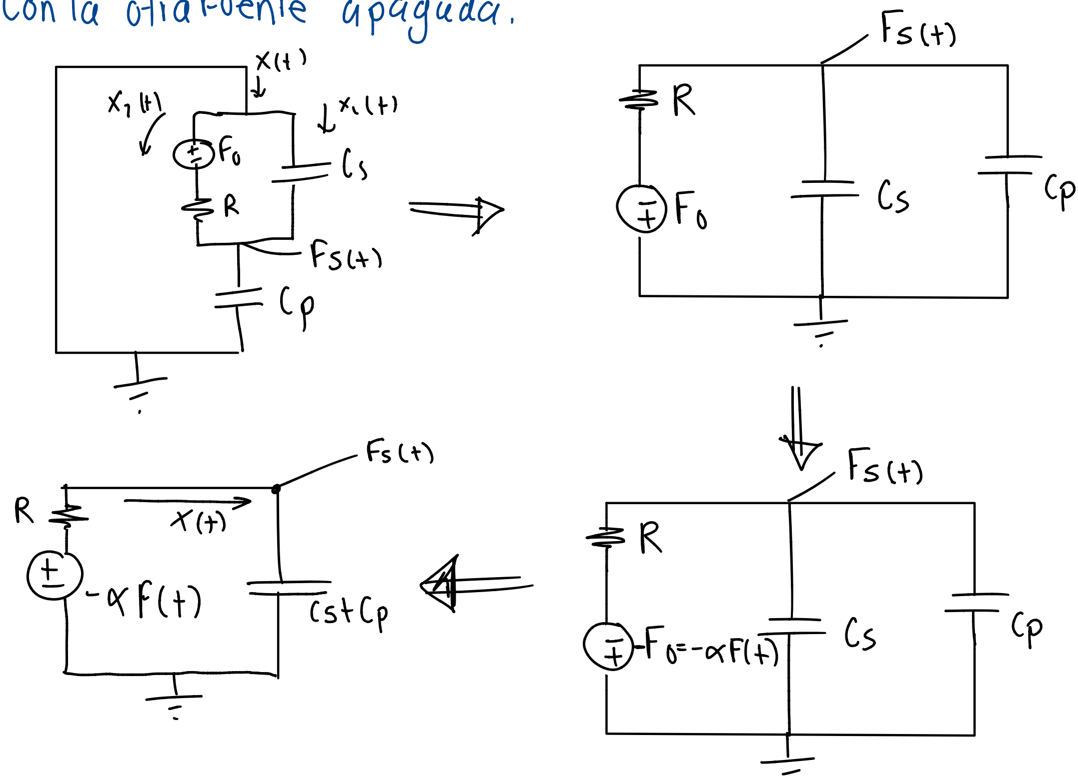
$$\frac{F_s(s)}{F(s)} = \frac{C_s R S + 1}{R}$$

$$\frac{F_s(s)}{F(s)} = \frac{C_s R + 1}{(C_p R + C_s R) + 1}$$

$$F_{s_1}(s) = \frac{C_s R_s + 1}{(C_p R + C_s R)s + 1} \quad F(s)$$

$$\boxed{\begin{aligned} F_0 &= \alpha F(t) \\ \alpha &= 0.25 \end{aligned}}$$

Con la otra fuente apagada.



$$-\alpha F(t) = Rx(t) + \frac{1}{C_s + C_p}\int x(t)\,dt$$

$$F_s(t) = \frac{1}{C_s + C_p}\int x(t)\,dt$$

Transformada

$$-\alpha F(s) = Rx(s) + \frac{x\,s}{(C_s + C_p)\,s}$$

$$F_s(s) = \frac{X(s)}{(C_s + C_p)\,s}$$

$$F(s) = \frac{R(C_s + C_p)s + 1}{(C_s + C_p)}\;\frac{X(s)}{-\alpha}$$

$$\frac{F_s(s)}{F(s)} = \frac{\frac{X(s)}{(C_s+C_p)s}}{\frac{R(C_s+C_p)s+1}{-\alpha(C_s+C_p)s}X(s)}$$

$$\frac{F_s(s)}{F(s)} = \frac{-\alpha}{R(C_s+C_p)s+1}$$

$$F_{s_2}(s) = \frac{-\alpha F(s)}{R((C_s+C_p)s+1}$$

$$F_s(s) = F_{s_1}(s) + F_{s_2}(s)$$

$$F_s(s) = \frac{(C_sRS+1)F(s)}{R(C_p+C_s)S+1} - \frac{\alpha F(s)}{R(C_p+C_s)S+1}$$

$$F_s(s) = \frac{C_sRs+1-\alpha}{R(C_p+C_s)S+1}F(s)$$

Función de transferencia.

$$\frac{F_s(s)}{F(S)} = \frac{C_sRS+1-\alpha}{R(C_p+C_s)s+1}$$

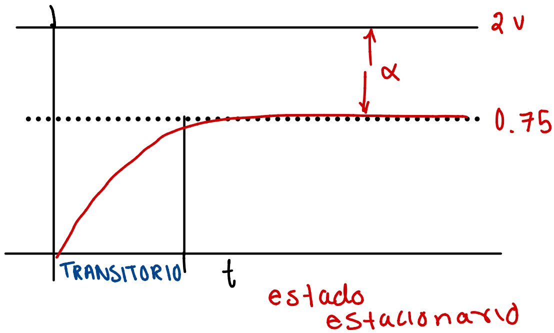
Error en estado estacionario

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

$$e(s) = \lim_{s \to 0} \cancel{s} * \frac{1}{\cancel{s}}\left[1 - \frac{\cancel{C_s R s} + 1 - \alpha}{\cancel{R(C_p + C_s)s} + 1}\right]$$

$$e(s) = \alpha$$

$$e(t) = \alpha V$$



Estabilidad en lazo abierto

$$R(C_p + C_s)s + 1 = \emptyset \qquad \mathrm{Re}\,\lambda < \emptyset$$

$$\lambda = -\frac{1}{R(C_p + C_s)}$$

"El sistema presenta una respuesta estable"