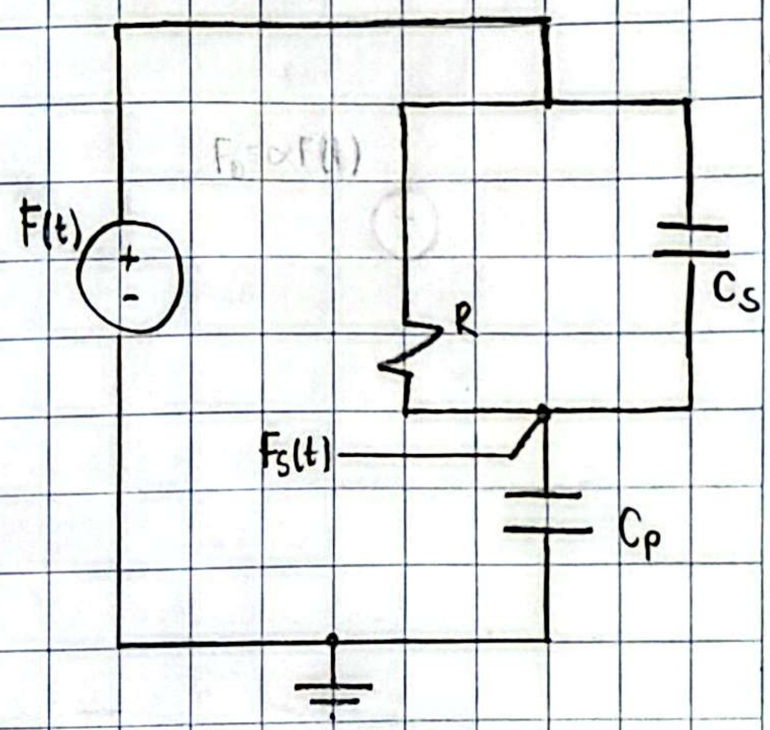
Sistema musculoesquelético

23- Octubre

Función de transferencia



Análisis apagando F_o

$$X(t) = X_1(t) + X_2(t)$$

$$X(t) = C_p \frac{d[F_s(t)]}{dt}$$

$$X_2(t) = \frac{F(t) - F_s(t)}{R} \qquad X_1(t) = C_s \frac{d[F(t) - F_s(t)]}{dt}$$

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

Transformada de Laplace

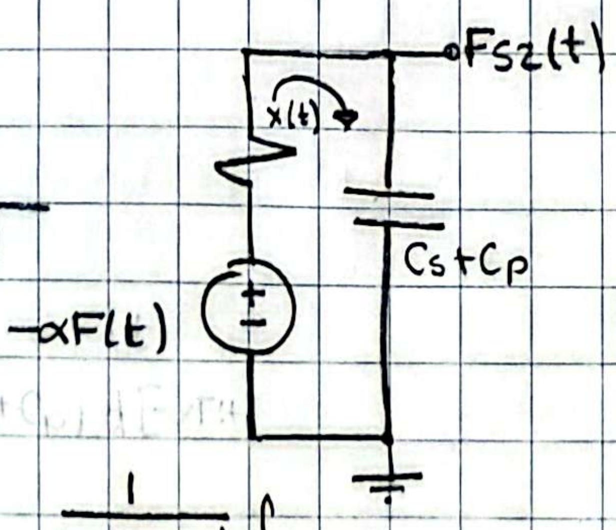
$$C_p S F_s(S) = C_s S[F(S) - F_s(S)] + \frac{F(S) - F_s(S)}{R}$$

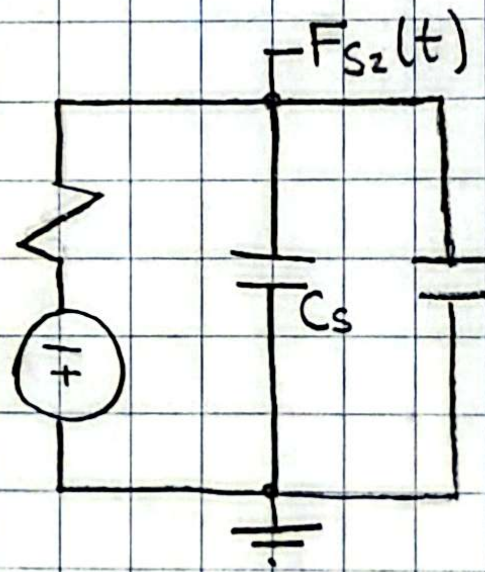
$$\left(C_p S + C_s S + \frac{1}{R}\right) F_s(S) = \left(C_s S + \frac{1}{R}\right) F(S)$$

$$\frac{F_s(S)}{F(S)} = \frac{C_s S + \frac{1}{R}}{C_p S + C_s S + \frac{1}{R}} = \left.\frac{\frac{RC_s S + 1}{R}}{\frac{RC_p S + RC_s S + 1}{R}}\right\} = \frac{RC_s S + 1}{(C_p R + C_s R) S + 1}$$

Análisis apagando $F(t)$

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





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

$$F_s(t) = \frac{1}{C_s + C_p} \int X(t)\, dt \qquad \therefore \quad -\alpha F(t) = R\, X(t) + F_s(t)$$

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

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

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

$$F_s(s) = F_{s1}(s) + F_{s2}(s)$$

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

$$\boxed{\frac{F_s(S)}{F(S)} = \frac{C_sRS+1-\alpha}{R(C_s+C_p)S+1}}$$ función de transferencia

Error en estado estacionario

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

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

$e(s) = \alpha$ $\boxed{e(t) = \alpha\ V}$ $e(t) = 0.25\ V$

Estabilidad en lazo abierto

$$\boxed{\lambda = -\frac{1}{R(C_p+C_s)}}$$ $\mathrm{Re}\ \lambda < \emptyset$

El sistema es estable

$R(C_p+C_s)S + 1 = 0$ Sistema de primer orden, por lo tanto, tiene una raíz.