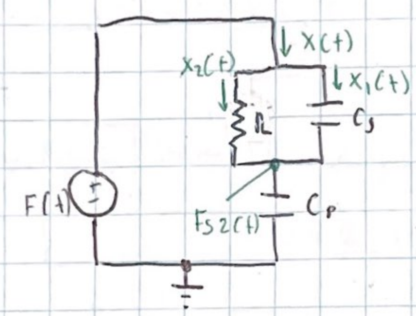
Modelado de sistemas fisiologicos 23/10/25

Sistema musculoesquelético

Función de transferencia

Análisis apagando F_0



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

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

$$x_2(t) = \frac{F(t) - F_s(t)}{R} \qquad x_1(t) = C_s \frac{d[F(t) - F_s(t)]}{dt}$$

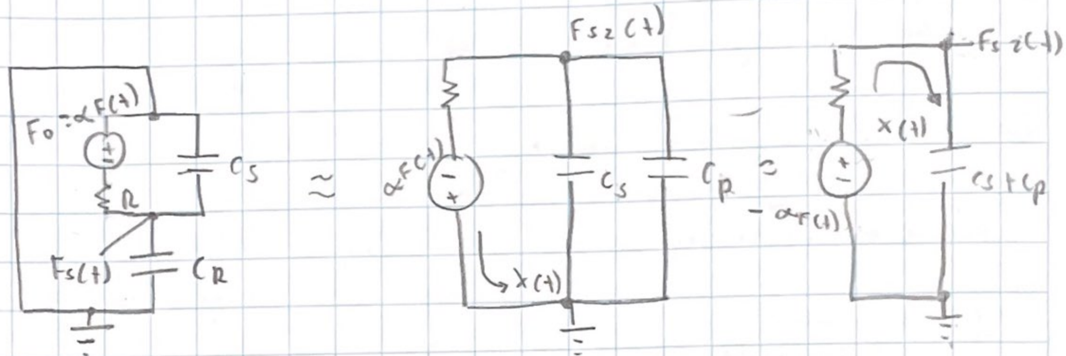
$$C_p \frac{dF_s(t)}{dt} = C_s \frac{d[F(t) - F_s(t)]}{dt} + \frac{F(t) - F_s(t)}{R}$$

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

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

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

Modelado de sistemas fisiologicos 23/10/23



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

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

Función de transferencia

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

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

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

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

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

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

Modelado de sistemas fisiologico 23/10/25

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

Estabilidad en lazo abierto

$$R(C_s + C_p)s + 1 = 0$$

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

$$R_e \lambda < 0$$

El sistema es estable si $\lambda < 0$

Error en estado estacionario

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

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

$$= 1 - \frac{1}{1} + \alpha$$

$$= \alpha$$