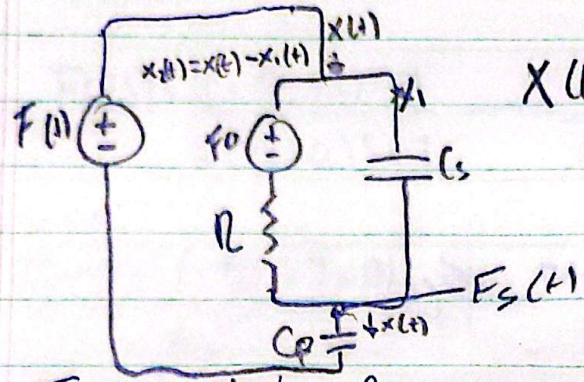
Sistema musculoesquelético

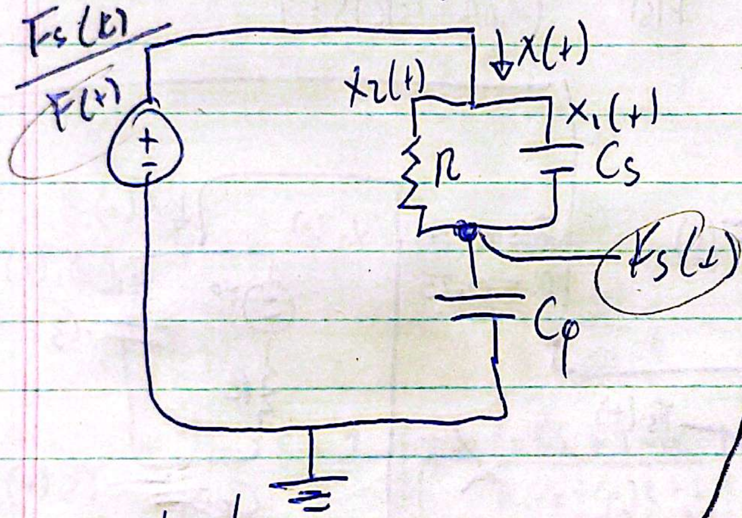
Circuito eléctrico



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

Funcion de transferencia

Analisis por superposicion



$$X\,t=X_1(x)+X_2(t)$$

Nodos con capacitador es una derivada

$$X(t)=C_p\frac{dF_s(t)}{dt}$$

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

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

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

Transformada de laplace

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

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

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

$$\frac{C_pRs + C_sRs + 1}{R} F_s(s) = \frac{C_sR_s + 1}{R} F(s)$$

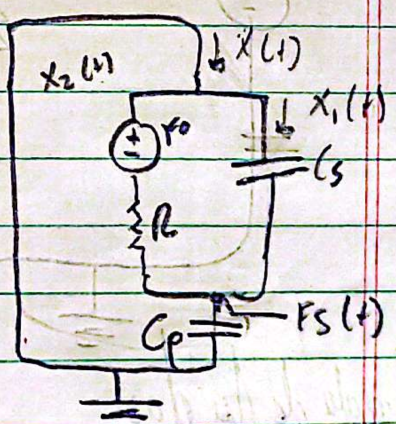
$$\frac{F_s(s)}{F(s)} = \frac{\frac{C_sRs+1}{R}}{\frac{(C_pR+C_sR)s+1}{R}}$$

$$\frac{F_s(s)}{F(s)} = \frac{C_sRs+1}{(C_pR+C_sR)s+1}$$

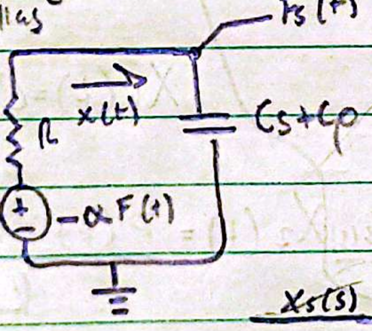
$$F_{s1}(s) = \frac{C_sRs+1}{(C_pR+C_sR)s+1} F(s)$$

$F\phi = \alpha F(t)$

$\alpha = 0.25$



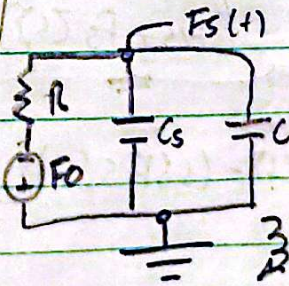
es por malla por la integral
Analisis por mallas



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

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

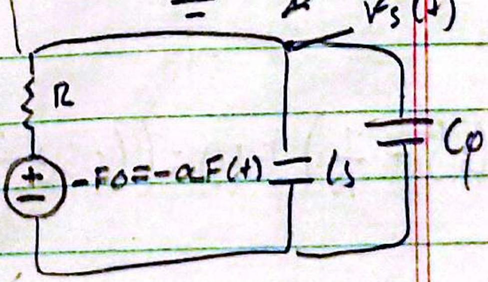
$$-\alpha F(s) = RX(s) + \frac{X(s)}{(C_s+C_p)s}$$



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

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

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



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

$$F_{s2}(s) = \frac{-\alpha F(s)}{R(C_s+C_p)s+1}$$

Funcion de Transferencia Completa

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

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

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

Parametro	Control	Caso
F(t)	1V	1V
α	0.25	0.25
C_s	10 µF	10 µF
C_p	100 µF	100 µF
R	100 Ω	10 kΩ

Funcion de trans

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

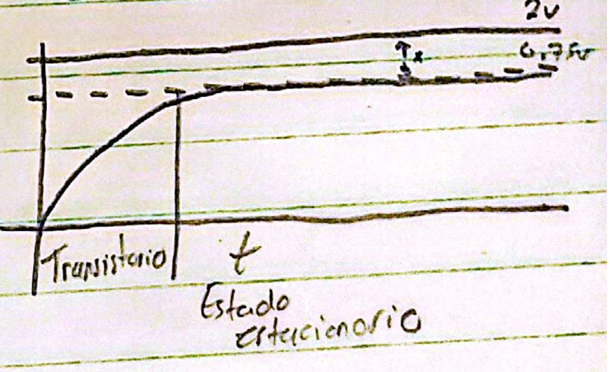
error en estado estacionario

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

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

$$e(s) = \alpha$$

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



Estabilidad en lazo abierto

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

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

$$\mathrm{Re}\,\lambda < 0$$

El sistema presenta una respuesta estable