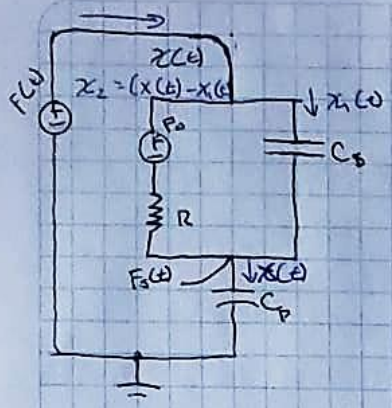
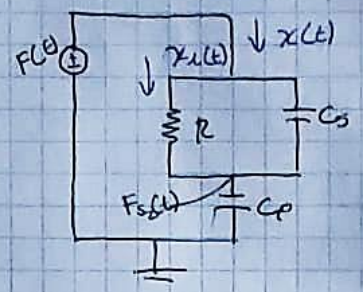
23-OCT-2025

Circuito eléctrico



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

Función de Transferencia
Analisis apagando F_0



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

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

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

$x_2(t) = \frac{F(t) - F_s(t)}{R}$

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

Transformada de Laplace

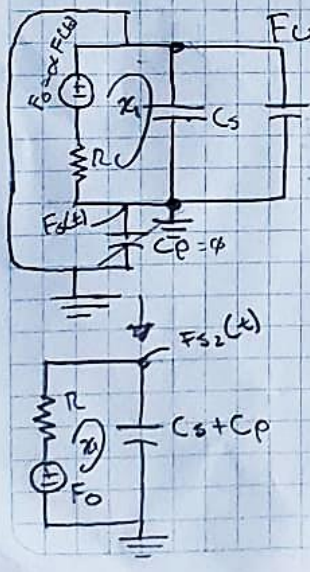
$C_p \frac{d F_s(t)}{dt} = C_s \frac{d[F(t) - F_s(t)]}{dt} + \frac{F(t) - F_s(t)}{R}$

$C_p s F_s(s) = C_s s [F(s) - F_s(s)] + F(s) - F_s(s)$

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

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

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



Función de transferencia
Apagando $F(t)$
$F_0 = \alpha F(s)$

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

Transformada de laplace

$$-\alpha F(s) = R X(s) - \frac{X(s)}{C_s s + C_p s} \qquad F_0(s) = \frac{X(s)}{C_s s + C_p s}$$

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

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

$$F_{s2}(s) = -\frac{\alpha F(s)}{R(C_s+C_p)s+1} \qquad F_s(s) = F_{s2}(s) + F_2(s)$$

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

Error en estado estacionario - Estabilidad lazo abierto

$$e(s) = \lim_{s\to\phi} sF(s)\left[1 - \frac{F_s(s)}{F(s)}\right] = \lim_{s\to\phi} s\cdot\frac{1}{s}\left[1 - \frac{C_sRs+1-\alpha}{R(C_p+C_s)s+1}\right]$$

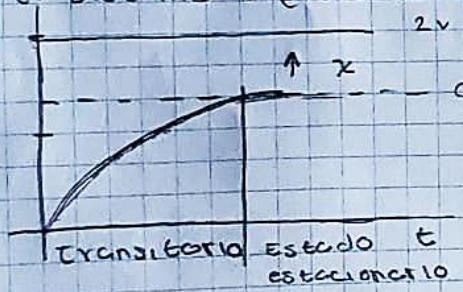
$$e(s) = \left[1 - \frac{1-\alpha}{1}\right] = 1-1+\alpha = \alpha \qquad e(t) = \alpha V$$

$$e(s) = \alpha$$

$R(C_p+C_s)s+1 = \phi$ — sistema de primer orden

$$\lambda = -\frac{1}{R(C_p+C_s)} \qquad Re\,\lambda < \phi$$

El sistema representa una respuesta estable



La respuesta es asintoticamente estable.