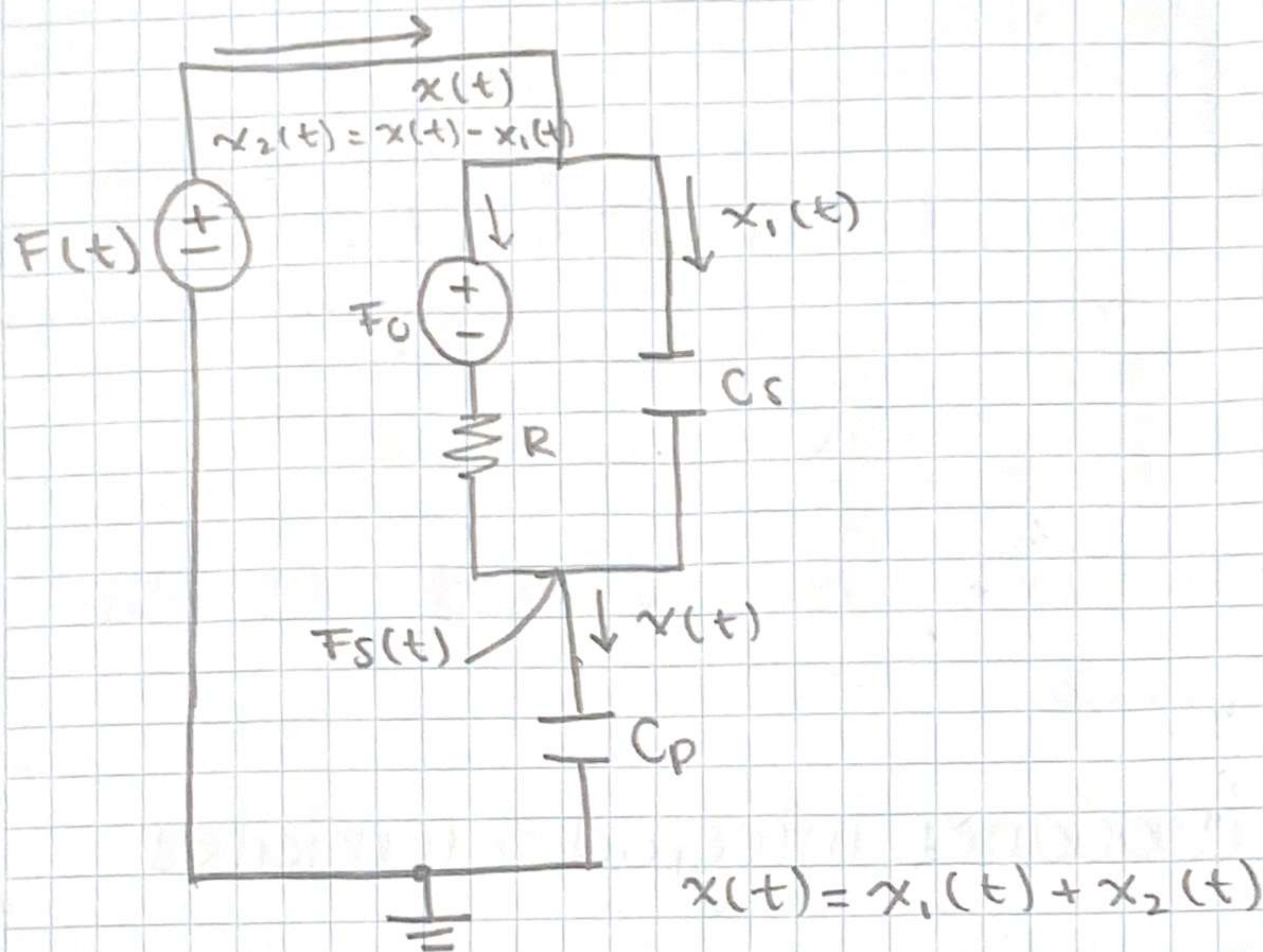


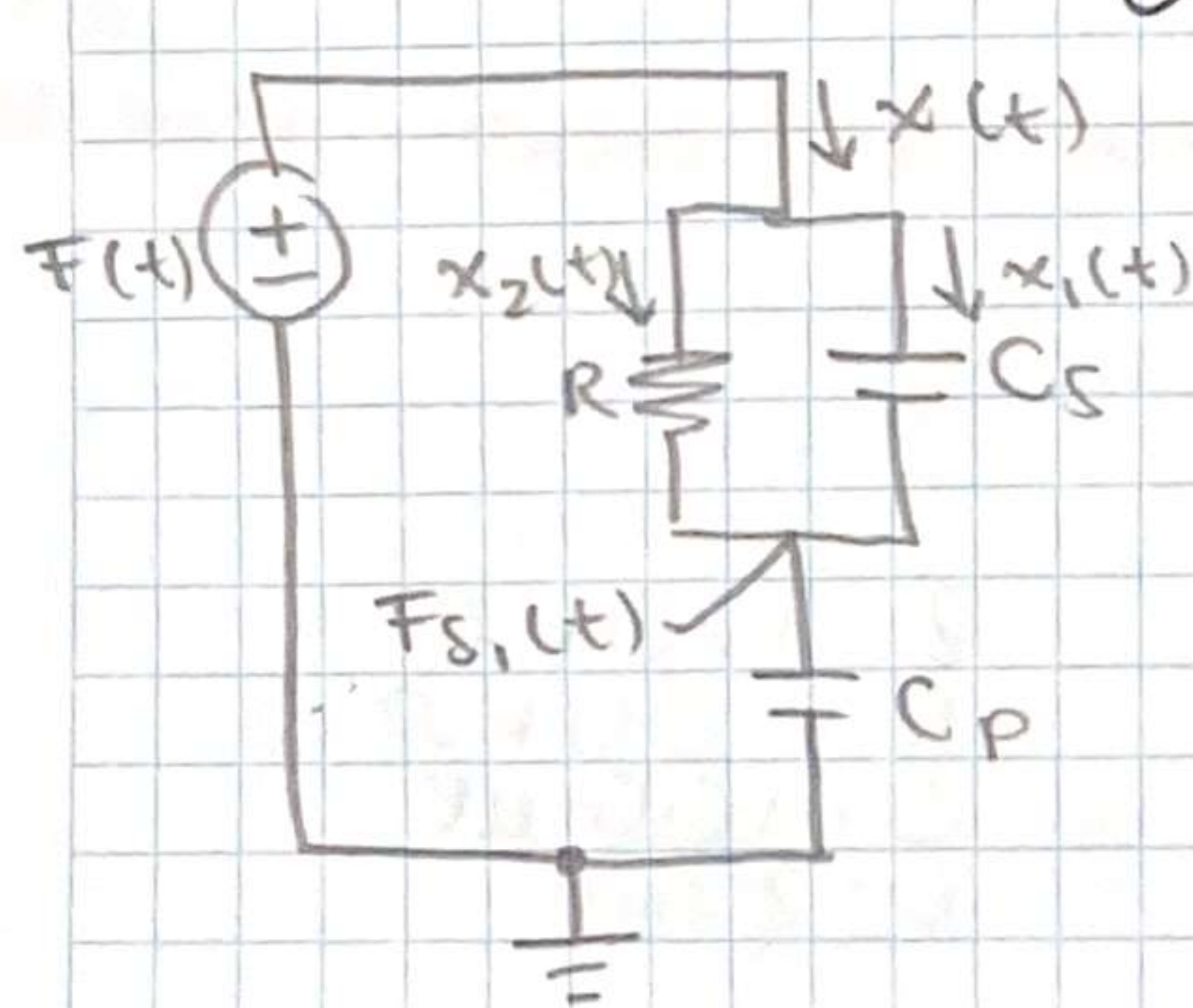
# Circuito eléctrico

23-oct-25



## Función de transferencia

→ Análisis apagando  $F_0$



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

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

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

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

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

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



$$\frac{RCs + 1}{R}$$

$$= \frac{R^2Cs + R}{R^2(Cp + Cs)s + R}$$

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

$$\frac{F_s(s)}{F(s)} = \frac{(Cs s + \frac{1}{R})}{(Cp s + Cs s + \frac{1}{R})} = \frac{Cs s + \frac{1}{R}}{(Cp + Cs)s + \frac{1}{R}} (R)$$

$$\frac{F_s(s)}{F(s)} = \frac{Cs R s + 1}{Cp R s + Cs R s + 1} = \frac{Cs R s + 1}{(Cp R + Cs R)s + 1}$$

$$F_{s1}(s) = \frac{(Cs R s + 1) F(s)}{R(Cs + Cp)s + 1}$$

$$F(t) = 1V - 1V$$

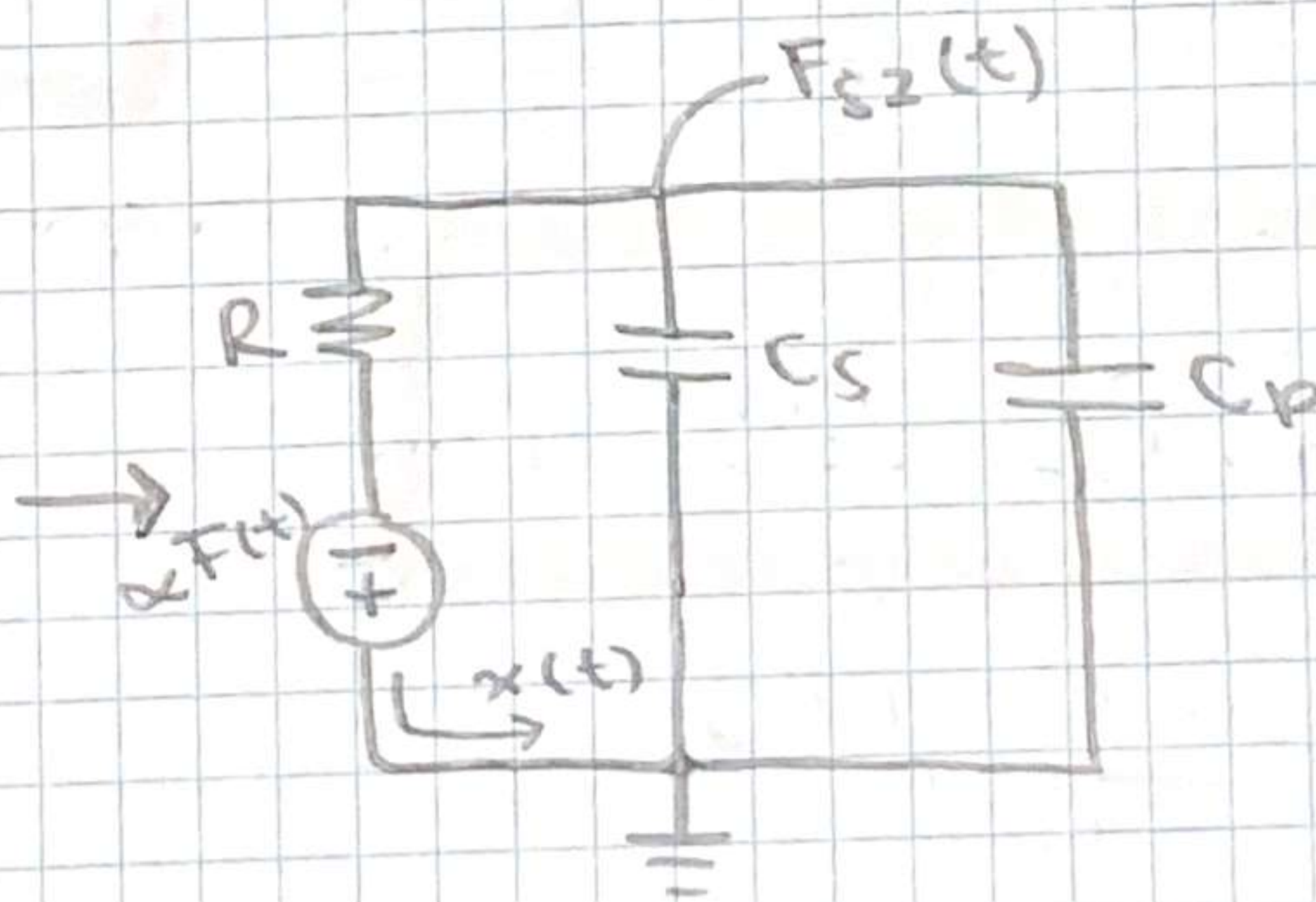
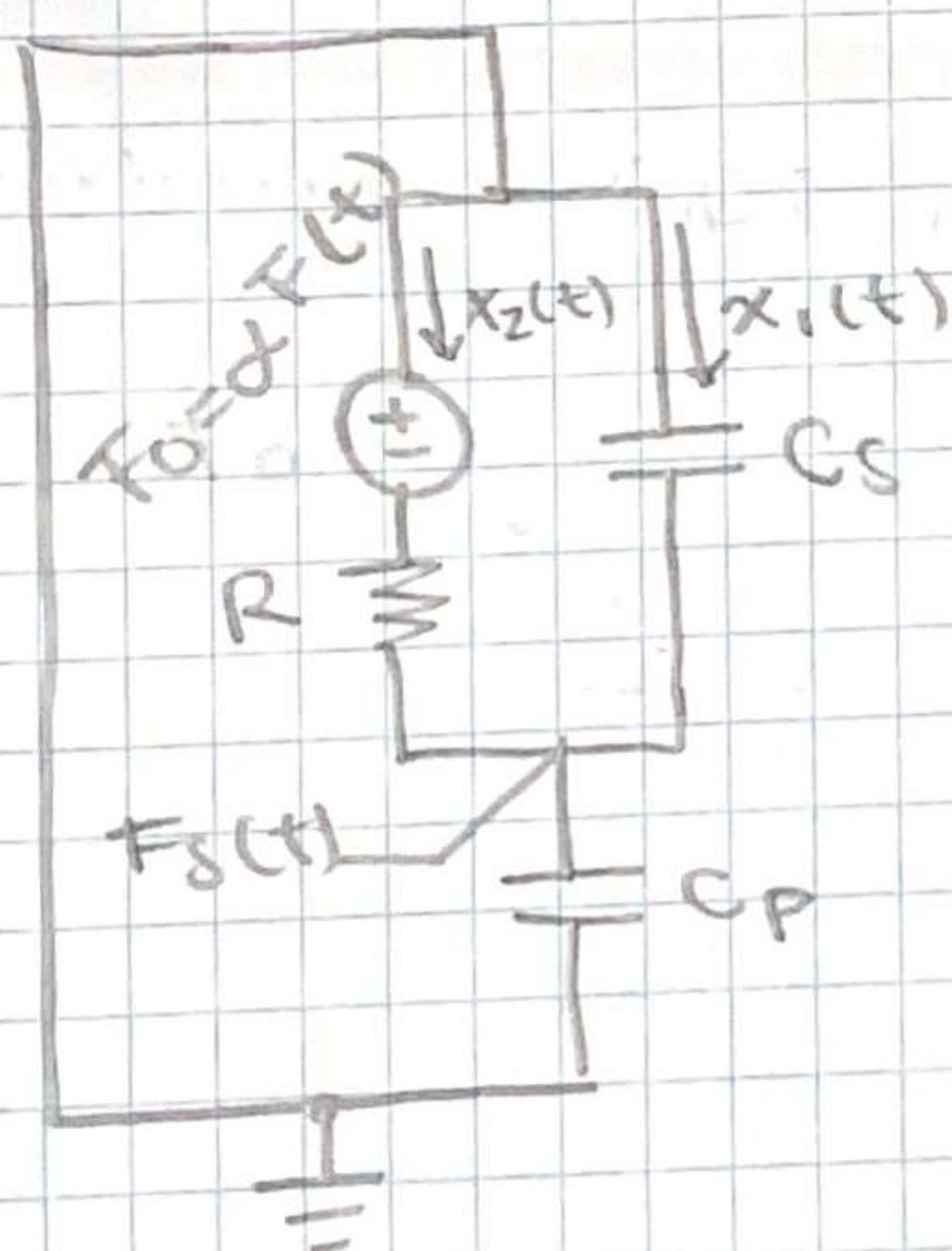
$$\alpha = 0.25 - 0.25$$

$$Cs = 10 \mu F$$

$$Cp = 100 \mu F$$

$$R = 100 - 10k$$

→ Análisis apagando  $F(t)$



$$\alpha F(t) = R x(t) + \frac{1}{(Cs + Cp)} \int x(t) dt$$

$$F_s(t) = \frac{1}{Cs + Cp} \int x(t) dt$$



## Error de estado estacionario y lazo abierto

$$-\alpha F(s) = R x(s) + \frac{x(s)}{(Cs + Cp)s} = \frac{R x(s)}{-\alpha} - \frac{x(s)}{\alpha (Cs + Cp)s}$$

$$F_s(s) = \frac{x(s)}{(Cs + Cp)s}$$

$$F_s = \frac{R x(s) (\alpha (Cs + Cp)s) + \alpha x(s)}{-\alpha^2 (Cs + Cp)s}$$

$$= \frac{x(s) [R (Cs + Cp)s + 1]}{-\alpha (Cs + Cp)s}$$

$$\frac{F_s(s)}{F_s} = \frac{\frac{x(s)}{(Cs + Cp)s}}{-\alpha x(s) \frac{R (Cs + Cp)s + 1}{\alpha (Cs + Cp)s}} = - \frac{\alpha}{R (Cs + Cp)s + 1}$$

$$F_{s2}(s) = \frac{-\alpha F_s}{R (Cs + Cp)s + 1}$$

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

$$F_s(s) = \frac{(CsRs + 1)F(s) - \alpha F(s)}{R(Cp + Cs)s + 1}$$

$$\frac{F_s(s)}{F(s)} = \frac{CsRs + 1 - \alpha}{R(Cp + Cs)s + 1}$$



## Error de estado estacionario

$$e(s) = \lim_{s \rightarrow 0} s \cdot F(s) \left[ 1 - \frac{F(s)}{F(s)_0} \right]$$
$$= \lim_{s \rightarrow 0} \left( s \cdot \frac{1}{s} \cdot \left( 1 - \frac{CSRS + 1 - \alpha}{R(Cp + Cs)S + 1} \right) \right) = 1 - 1 + \alpha$$

$$e(s) = +\alpha = \alpha V = 0.25V$$

## Estabilidad en lazo abierto

$$R(Cp + Cs)S + 1 = 0$$

$$R(Cp + Cs)S = -1$$

$$S = -\frac{1}{R(Cp + Cs)}$$

$$\lambda = -\frac{1}{R(Cp + Cs)}$$

→ La respuesta es estable.

→ Es asintóticamente estable.