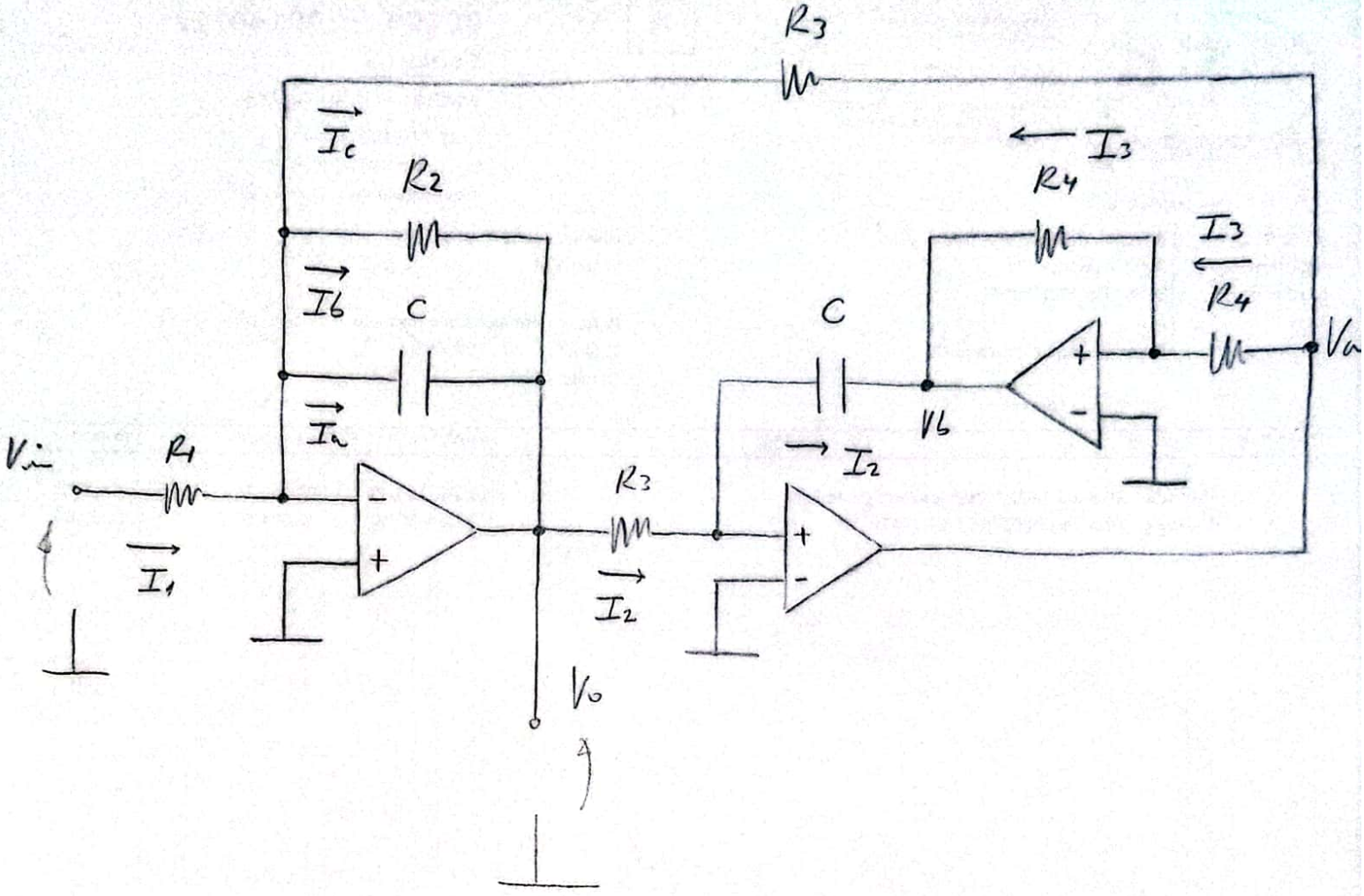

$$I_1 = \frac{V_{in}}{R_1} \quad ; \quad I_a = -V_o \cdot sC \quad ; \quad I_b = -\frac{V_o}{R_2} \quad ; \quad I_c = -\frac{V_a}{R_3}$$

$$I_1 = I_a + I_b + I_c$$

$$I_2 = \frac{V_o}{R_3} = -V_b\, sC \quad ; \quad \boxed{V_b = -\frac{V_o}{sR_3C}} \quad ; \quad \boxed{V_a = -V_b = \frac{V_o}{sR_3C}}$$

$$I_1 = \frac{V_{in}}{R_1} = I_a + I_b + I_c = -V_b\, sC + \left(-\frac{V_o}{R_2}\right) + \left(-\frac{V_o}{sR_3^2C}\right)$$

$$\frac{V_{in}}{R_1} = -V_o\left(sC + \frac{1}{R_2} + \frac{1}{sR_3^2C}\right) \quad ; \quad \frac{V_{in}}{R_1} = -V_o\left(\frac{s^2R_2R_3^2C^2 + sR_3^2C + R_2}{sR_2R_3^2C}\right)$$

$$T(s) = \frac{V_o}{V_{in}} = -\frac{s R_2 R_3^2 C}{s^2 R_1 R_2 R_3^2 C^2 + s R_1 R_3^2 C + R_1 R_2}$$

$$T(s) = \frac{V_o}{V_{in}} = -\frac{R_2 R_3^2 C}{R_1 R_2 R_3^2 C^2} \cdot \frac{s}{s^2 + s\frac{1}{R_2 C} + \frac{1}{R_3^2 C^2}}$$

$$T(s) = \frac{V_o}{V_{in}} = -\left(\frac{1}{R_1 C}\right) \frac{s}{s^2 + s\left(\frac{1}{R_2 C}\right) + \left(\frac{1}{R_3^2 C^2}\right)}$$

h $\quad \frac{\omega_o}{q}$ $\quad \omega_o^2$

; $\boxed{h = \frac{1}{R_1 C}}$

$$T(s) = \frac{V_o}{V_{in}} = -h \frac{s}{s^2 + s\frac{\omega_o}{q} + \omega_o^2}$$

; $\boxed{\omega_o = \frac{1}{R_3 C}}$

; $\frac{\omega_o}{q} = \frac{1}{R_2 C}$; $\frac{1}{R_3 C q} = \frac{1}{R_2 C}$

$$\boxed{q = \frac{R_2}{R_3}}$$

$$\Omega_\omega = \omega_0 = \frac{1}{R_3 C}$$

$$T(s) = -h \frac{s}{s^2 + s\frac{1}{R_2 C} + \frac{1}{R_3^2 C^2}} = -\frac{R_3}{R_1 R_3 C} \frac{s}{s^2 + s\frac{\omega_0}{q} + \omega_0^2}$$

$$\phi = \frac{s}{\Omega_\omega} = \frac{s}{\omega_0} \quad ; \quad T(\phi) = -\frac{R_3}{R_1}\omega_0 \frac{\phi\omega_0}{\phi^2\omega_0^2 + \phi\omega_0\frac{\omega_0}{q} + \omega_0^2}$$

En adelante, $\phi = s$, recordando que corresponde a la frecuencia normalizada:

$$T(s) = -\frac{R_3}{R_1}\frac{\omega_0^2}{\omega_0^2} \frac{s}{s^2 + s\frac{1}{q} + 1}$$

$$\boxed{T(s) = -\frac{R_3}{R_1} \frac{s}{s^2 + s\frac{1}{q} + 1}}$$

Para $\omega_0 = 1$; $C = \frac{1}{R_3}$; Elijo $R_3 = 10K$; $C = 100\mu F$

Para $q = 3$; $R_2 = 3 R_3 \longrightarrow$ $R_2 = 30K$; $R_{2\_norm} = \begin{matrix} 27K \\ 33K \end{matrix}$

No hay restricciones para los valores de R_1 y R_4, elijo los mismos valores del circuito anterior: $R_1 = 1K$, $R_4 = 1K$

$$\Omega_z = R_3$$

$$R_{3\_n} = \frac{R_3}{\Omega_z} = 1 \quad ; \quad C_n = C \cdot \Omega_z = \frac{1}{R_3} R_3 = 1$$

$$q = \frac{R_2}{R_3} = \frac{R_2}{\Omega_z} \quad ; \quad R_{2\_n} = q$$

$$R_{1\_n} = \frac{R_1}{\Omega_z} = \frac{R_1}{R_3} = \frac{1K}{10K} = 0,1$$

$$R_{4\_n} = \frac{R_4}{\Omega_z} = \frac{R_4}{R_3} = \frac{1K}{10K} = 0,1$$