N_1

$$\frac{V_i - V_1}{R_1} = \frac{V_1 - V_2}{R_2} + C_2 \frac{d(V_o - V_1)}{dt}$$

N_2

$$\frac{V_1 - V_2}{R_2} = C_1 \frac{dV_2}{dt}$$

$$V_1$$

N_3

$$\frac{V_0 - V_3}{R_4} = \frac{V_3 - 0}{R_3}$$

$$V_2 = V_3$$

Expandiendo C_2

$$\frac{V_i - V_1}{R_1} = \frac{V_1 - V_2}{R_2} + C_2 \frac{dV_o}{dt} - C_2 \frac{dV_1}{dt}$$

Despejando V_i

$$\frac{V_i}{R_1} - \frac{V_1}{R_1} = \frac{V_1}{R_2} - \frac{V_2}{R_2} + C_2 \frac{dV_o}{dt} - C_2 \frac{dV_1}{dt} \rightarrow \frac{V_i}{R_1} = \frac{V_1}{R_2} - \frac{V_2}{R_2} + C_2 \frac{dV_o}{dt} - C_2 \frac{dV_1}{dt} + \frac{V_1}{R_1}$$

$$\rightarrow V_i = \frac{R_1}{R_2} V_1 - \frac{R_1}{R_2} V_2 + R_1 C_2 \frac{dV_o}{dt} - R_1 C_2 \frac{dV_1}{dt} + V_1$$

Despejando V_3 de N_3

$$\frac{V_0}{R_4} - \frac{V_3}{R_4} = \frac{V_3}{R_3}$$

$$\left(\frac{V_0}{R_4} = \frac{V_3}{R_3} + \frac{V_3}{R_4} \right) R_4 R_3$$

$$R_3 V_0 = V_3 R_4 + V_3 R_3$$

$$R_3 V_0 = (R_4 + R_3) V_3$$

$$\frac{R_3}{(R_4 + R_3)} V_0 = V_3 \qquad \dot{V}_3 = \frac{R_3}{(R_4 + R_3)} \frac{dV_o}{dt}$$

$$V_3 = V_2 \rightarrow \text{Por el op ideal}$$

Despejando V_1 de N_2

$$\frac{V_1}{R_2} - \frac{V_2}{R_2} = C_1 \frac{dV_2}{dt}$$

$$\left(\frac{V_1}{R_2} = C_1 \frac{dV_2}{dt} + \frac{V_2}{R_2} \right) R_2$$

$$V_1 = C_1 R_2 \frac{dV_2}{dt} + V_2$$

Sustituyendo V_3 en V_2

$$V_1 = C_1 R_2 \left(\frac{R_3}{(R_4 + R_3)} \frac{dV_o}{dt} \right) + \frac{R_3}{(R_4 + R_3)} V_0$$

$$\dot{V}_1 = C_1 R_2 \left(\frac{R_3}{(R_4 + R_3)} \frac{d^2 V_o}{dt} \right) + \frac{R_3}{(R_4 + R_3)} \frac{dV_o}{dt}$$

Sustituyendo v_1 en v_i

$$v_i = \frac{R1}{R2}\left[C_1 R2\left(\frac{R3}{(R4+R3)}\frac{dv_o}{dt}\right) + \frac{R3}{(R4+R3)}v_o\right] - \frac{R1}{R2}\left(\frac{R3}{(R4+R3)}v_o\right)$$

$$+ R1C2\frac{dv_o}{dt} - R1C2\left[C_1R2\left(\frac{R3}{(R4+R3)}\frac{d^2v_o}{dt}\right) + \frac{R3}{(R4+R3)}\frac{dv_o}{dt}\right]$$

$$+ C_1 R2\left(\frac{R3}{(R4+R3)}\frac{dv_o}{dt}\right) + \frac{R3}{(R4+R3)}v_o$$

Agrupando terminos

$$v_i = R1C1\left(\frac{R3}{(R4+R3)}\frac{dv_o}{dt}\right) + \frac{R1\,R3}{R2(R4+R3)}v_o - \frac{R1\,R3}{R2(R4+R3)}v_o$$

$$+ R1C2\frac{dv_o}{dt} - R1C2C1R2\left(\frac{R3}{R4+R3}\right)\frac{d^2v_o}{dt} - \frac{R1C2\,R3}{(R4+R3)}\frac{dv_o}{dt}$$

$$\underbrace{A}\qquad \underbrace{\ddot{V_o}}\qquad \dot{V_o}\qquad \dot{V_o}$$

$$\left[v_i = -\frac{R1\,R2\,R3\,C1C2}{R4+R3}\frac{d^2v_o}{dt} + \frac{R1\,R3\,C1}{R4+R3}\frac{dv_o}{dt} - \frac{R1\,R3\,C2}{R4+R3}\frac{dv_o}{dt}\right.$$

$$+ R1C2\frac{dv_o}{dt} + \frac{C1R2\,R3}{R4+R3}\dot{V_o} + \frac{C_1\,R3\,R2}{R4+R3}v_o$$

$$X_1 = V_0 \qquad \dot{X}_1 = \dot{V}_0$$

$$X_2 = \dot{V}_0 \qquad \dot{X}_2 = \ddot{V}_0$$

$$\frac{1}{A} - A\ddot{V}_0 = V_i - \frac{R1\,R3\,C1}{R4+R3}\dot{V}_0 + \frac{R1\,R3\,C2}{R4+R3}\ddot{V}_0 - R1\,C2\,\ddot{V}_0 - \frac{C1\,R2\,R3}{R4+R3}\dot{V}_0$$

$$- \frac{C1\,R3\,R2}{R4+R3}V_0$$

$$\smile$$

$$\ddot{V}_0 = -\frac{V_i}{A} + \frac{R1\,R3\,C1}{R4+R3}\frac{1}{A}\dot{V}_0 - \frac{R1\,C2\,R3}{R4+R3}\frac{1}{A}\dot{V}_0 + \frac{R1\,C2}{A}\ddot{V}_0$$

$$+ \frac{C1\,R2\,R3}{R4+R3}\dot{V}_0 + \frac{C1\,R3\,R2}{R4+R3}V_0$$