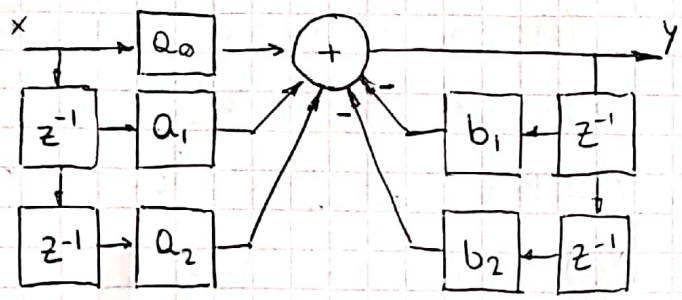
7)

a)



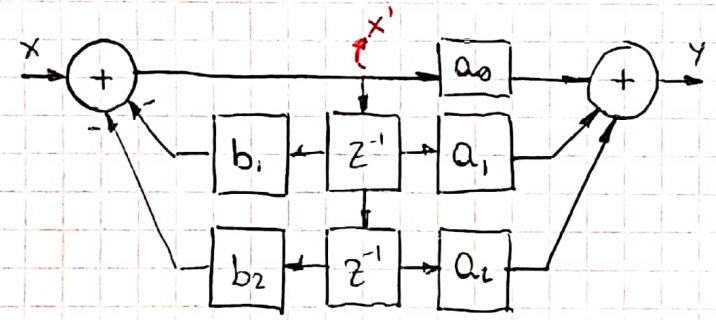

$$y(k) = a_0 x(k) + a_1 x(k-1) + a_2 x(k-2) - b_1 y(k-1) - b_2 y(k-2)$$

$$Y(z) = a_0 X(z) + a_1 X(z) z^{-1} + a_2 X(z) z^{-2} - b_1 Y(z) z^{-1} - b_2 Y(z) z^{-2}$$

$$Y(z)\left[1 + b_1 z^{-1} + b_2 z^{-2}\right] = X(z)\left[a_0 + a_1 z^{-1} + a_2 z^{-2}\right]$$

$$\frac{Y(z)}{X(z)} = H(z) = \frac{a_0 + a_1 z^{-1} + a_2 z^{-2}}{1 + b_1 z^{-1} + b_2 z^{-2}}$$ → FILTRO IIR

b)




$$x'(k) = x(k) - b_1 x'(k-1) - b_2 x'(k-2)$$

$$X'(z) = X(z) - b_1 X'(z) z^{-1} - b_2 X'(z) z^{-2}$$

$$X'(z)\left[1 + b_1 z^{-1} + b_2 z^{-2}\right] = X(z)$$

$$X'(z) = \frac{X(z)}{1 + b_1 z^{-1} + b_2 z^{-2}}$$

$$y(k) = a_0 x'(k) + a_1 x'(k-1) + a_2 x'(k-2)$$

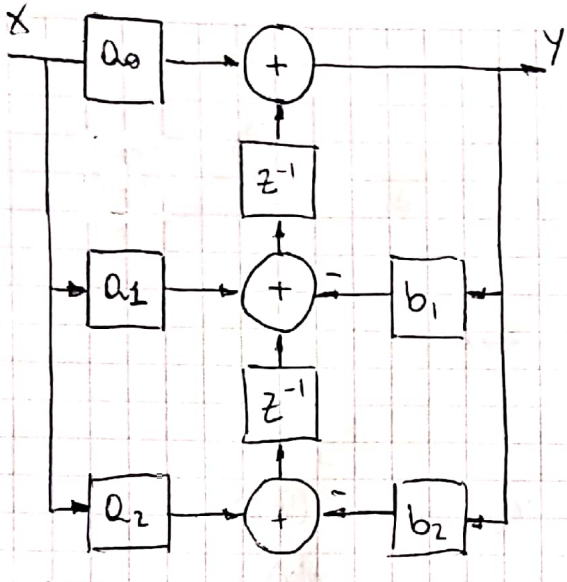
$$Y(z) = a_0 X'(z) + a_1 X'(z) z^{-1} + a_2 X'(z) z^{-2}$$

$$Y(z) = X'(z)\left[a_0 + a_1 z^{-1} + a_2 z^{-2}\right]$$

$$Y(z) = \frac{a_0 + a_1 z^{-1} + a_2 z^{-2}}{1 + b_1 z^{-1} + b_2 z^{-2}} X(z)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{a_0 + a_1 z^{-1} + a_2 z^{-2}}{1 + b_1 z^{-1} + b_2 z^{-2}}$$

c)




$$\left[\left[a_2 \cdot X(z) - b_2 \cdot Y(z)\right] z^{-1} + a_1 X(z) - b_1 Y(z)\right] z^{-1} + X(z) a_0 = Y(z)$$

$$\left[a_2 X(z) z^{-1} - b_2 Y(z) z^{-1} + a_1 X(z) - b_1 Y(z)\right] z^{-1} + X(z) a_0 = Y(z)$$

$$a_2 X(z) z^{-2} - b_2 Y(z) z^{-2} + a_1 X(z) z^{-1} - b_1 Y(z) z^{-1} + a_0 \cdot X(z) = Y(z)$$

$$X(z)\left[a_0 + a_1 z^{-1} + a_2 z^{-2}\right] - Y(z)\left[b_1 z^{-1} + b_2 z^{-2}\right] = Y(z)$$

$$Y(z)\left[1 + b_1 z^{-1} + b_2 z^{-2}\right] = X(z)\left[a_0 + a_1 z^{-1} + a_2 z^{-2}\right]$$

$$\frac{Y(z)}{X(z)} = H(z) = \frac{a_0 + a_1 z^{-1} + a_2 z^{-2}}{1 + b_1 z^{-1} + b_2 z^{-2}}$$

↳ Los 3 esquemas representan la misma $H(z)$, que es un filtro IIR bicuadrático