1) a) $$-X_{(z)}\cdot z^{-N}\cdot c_1 + X_{(z)} + W_{(z)}\cdot a_0\cdot z^{-1}\cdot a_1 + W_{(z)}\cdot a_0\cdot a_2\cdot z^{-2} = W_{(z)}$$

b $W_{(z)}$

$$Y_{(z)} = W_{(z)}\cdot a_0\left(b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2\right)$$

$$W_{(z)} = \frac{Y_{(z)}}{a_0\cdot\left(b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2\right)}$$

$$X_{(z)}\cdot\left(1 - z^{-N} c_1\right) + \frac{Y_{(z)}\cdot a_1\cdot z^{-1}}{\left(b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2\right)} + \frac{Y_{(z)}\cdot a_2\cdot z^{-2}}{b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2} = \frac{Y_{(z)}}{a_0\cdot\left(b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2\right)}$$

$$X_{(z)}\cdot\left(1 - z^{-N}\cdot c_1\right) = Y_{(z)}\cdot\left(\frac{1}{a_0\cdot\left(b_0 + z^{-1} b_1 + z^{-2} b_2\right)} - \frac{a_1\cdot z^{-1}}{b_0 + z^{-1} b_1 + z^{-2} b_2} - \frac{a_2\cdot z^{-2}}{b_0 + z^{-}}\right)$$

$$X_{(z)}\cdot\left(1 - z^{-N}\cdot c_1\right) = Y_{(z)}\left(\frac{1 - a_0\cdot a_1\cdot z^{-1} - a_0\cdot a_2\cdot z^{-2}}{a_0\cdot\left(b_0 + z^{-1}\cdot b_1 + z^{-2}\cdot b_2\right)}\right)$$

$$H_{(z)} = \left(1 - c_1\cdot z^{-N}\right)\cdot\left(\frac{z^{-2}\cdot a_0 b_2 + z^{-1}\cdot a_0 b_1 + a_0\cdot b_0}{-z^{-2}\cdot a_0 a_2 - z^{-1}\cdot a_0 a_1 + 1}\right)$$

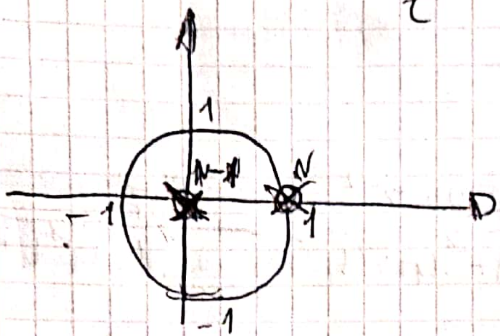
$$\boxed{H_{(z)} = \left(1 - c_1\cdot z^{-N}\right)\cdot\left(\frac{z^{-2}\cdot b_2 + z^{-1}\cdot b_1 + b_0}{-z^{-2}\cdot a_2 - z^{-1}\cdot a_1 + \frac{1}{a_0}}\right)}$$

$$H_{(z)} = \left(\frac{z^N - c_1}{z^N}\right)\cdot\left(\frac{z^2\cdot b_0 + z\cdot b_1 + b_2}{\frac{z^2}{a_0} - z\cdot a_1 - a_2}\right)$$

NOTA

(b) $\boxed{H(z) = (1 - z^{-N}) \cdot \left(\frac{\frac{1}{N}}{1 - z^{-1}} \right)} = \boxed{\frac{1}{N} \cdot \left(\frac{1 - z^{-N}}{1 - z^{-1}} \right)}$ ✓

$$H(z) = \frac{1}{N} \cdot \frac{\frac{z^N - 1}{z^N}}{\frac{z - 1}{z}} = \frac{1}{N} \cdot \frac{(z^N - 1)}{z^{N-1}(z - 1)}$$



según su definición es un filtro IIR ya que $|a_i| \neq 0$, pero se comporta como FIR ya que es siempre estable

$$H_6(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5} + z^{-6}$$

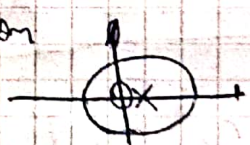
se puede lograr usando 3 de estas redes en cascada

(c) Para diferenciador de 1er orden: $\boxed{b_0 = a_2 = 0}$ $\boxed{a_0 \to \infty}$ $\boxed{b_1 = 1}$ $\boxed{b_2 = -1}$ $\boxed{a_1 = -1}$

De 2º orden: $\boxed{b_0 = a_0 = 1}$ $\boxed{b_1 = a_1 = a_2 = 0}$ $\boxed{b_2 = -1}$

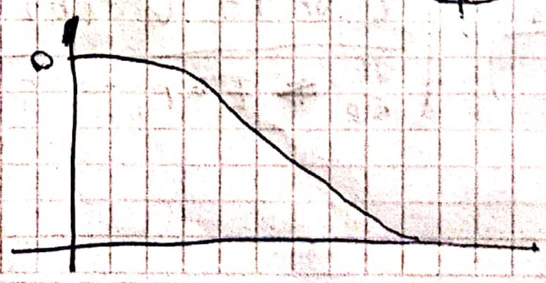
(d) Para $\alpha = 0{,}9 \Rightarrow \boxed{H(z) = \frac{0{,}9 z^2}{z^2 - 0{,}1 z}}$

$\boxed{H(z) = \frac{0{,}9 z}{z - 0{,}1}}$ Es un integrador



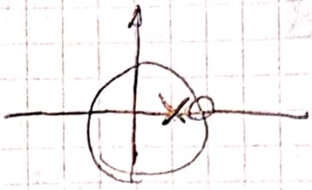
$$\frac{0{,}9 e^{j\Omega}}{e^{j\Omega} - 0{,}1}$$

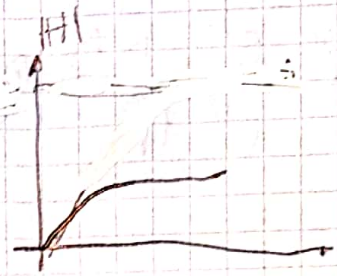
$$\frac{0{,}9 e^{j\Omega}}{0{,}1 e^{j\Omega/2} \left(\frac{e^{j\Omega/2}}{0{,}1} + e^{-j\Omega/2} \right)}$$



(e) $H_{(z)} = \dfrac{z^2 - z}{z^2 - \alpha \cdot z} = \dfrac{z-1}{z-\alpha}$

Para $\alpha = 0{,}9$ $\quad \dfrac{z-1}{z-0{,}9}$





$$H_{(e^{j\Omega})} = \frac{e^{j\Omega} - 1}{e^{j\Omega} - 0{,}9} = \frac{\cos\Omega + j\,\text{sen}\,\Omega - 1}{\cos\Omega + j\,\text{sen}\,\Omega - 0{,}9} \qquad |H e^{j\Omega}| = \frac{\sqrt{(\cos\Omega - 1)^2 + \text{sen}^2\Omega}}{\sqrt{(\cos\Omega - 0{,}9)^2 + \text{sen}^2\Omega}}$$

$$|H e^{j\Omega}| = \frac{\sqrt{2(1-\cos\Omega)}}{\sqrt{1{,}81 - 1{,}8\cos\Omega}} \qquad |H_{(\Omega=\pi)}| = 20 \cdot \log\left(\frac{\sqrt{2 \cdot (1-\cos\pi)}}{\sqrt{1{,}81 - 1{,}8 \cdot \cos\pi}}\right)$$

$$|H e^{j\Omega}| = \frac{\sqrt{2 \cdot (1 - \cos(\Omega))}}{\sqrt{(1+\alpha^2) - 2\alpha \cdot \cos\Omega}}$$

$-1{,}74$

$$3 = 20\log\left(\frac{\sqrt{2 \cdot (1-\cos\pi)}}{\sqrt{(1+\alpha^2) - 2\alpha \cdot \cos\pi}}\right) - 20\log\left(\frac{\sqrt{2 \cdot (1-\cos(0{,}1\pi))}}{\sqrt{(1+\alpha^2) - 2\alpha \cdot \cos 0{,}1\pi}}\right)$$

$1{,}2596$

$$\frac{3}{20} = \log\left(\frac{\dfrac{2}{\sqrt{(1+\alpha^2) + 2\alpha}}}{\dfrac{0{,}31}{\sqrt{(1+\alpha^2) - \alpha 1{,}9}}}\right)$$

$$10^{0{,}15} = \frac{2}{0{,}31} \cdot \frac{\sqrt{\alpha^2 - 1{,}9\alpha + 1}}{\sqrt{\alpha^2 + 2\alpha + 1}} \Rightarrow 0{,}21894 = \frac{\sqrt{\alpha^2 - 1{,}9\alpha + 1}}{\sqrt{\alpha^2 + 2\alpha + 1}}$$

$$0{,}04793 \cdot (\alpha^2 + 2\alpha + 1) = \alpha^2 - 1{,}9\alpha + 1$$

NOTA

$$\alpha^2\, 0{,}95206 - \alpha\, 1{,}99386\; 0{,}95206 \qquad \boxed{\alpha = 0{,}73}$$

Escaneado con CamScanner