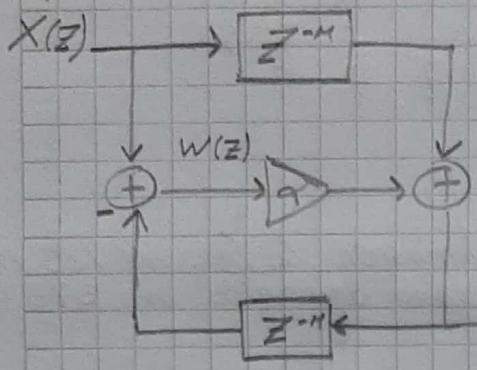
2)

$H=2$ y $\alpha=0,8$



$$\begin{cases} W(z) = X(z) - Y(z)\,z^{-2} & (1) \\ Y(z) = W(z)\,0,8 + X(z)\,z^{-2} & (2) \end{cases}$$

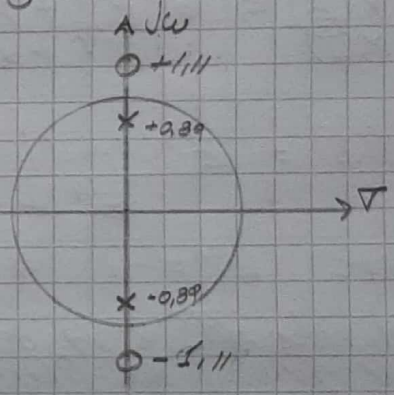
→ ES IIR xq está realimentado

(1) en (2) → $Y(z) = [X(z) - Y(z)\,z^{-2}]\,0,8 + X(z)\,z^{-2}$

$Y(z)[1 + 0,8\,z^{-2}] = X(z)[0,8 + z^{-2}]$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{0,8 + z^{-2}}{1 + 0,8\,z^{-2}} = \frac{z^2 0,8 + 1}{z^2 + 0,8}$$

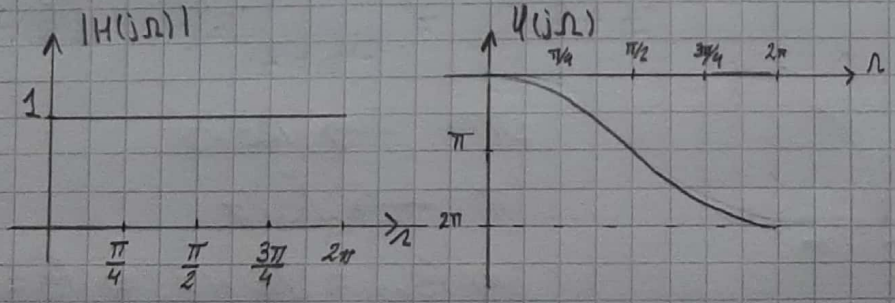
$$H(z) = 0,8\,\frac{z^2 + 1,25}{z^2 + 0,8}$$



ceros $= (0 \pm j\sqrt{5/2}) = (0 \pm j\,1,11)$

Polos $= (0 \pm j0,89)$

$$H(j\Omega) = 0,8 \cdot \frac{e^{j2\Omega} + 1,25}{e^{j2\Omega} + 0,8}$$

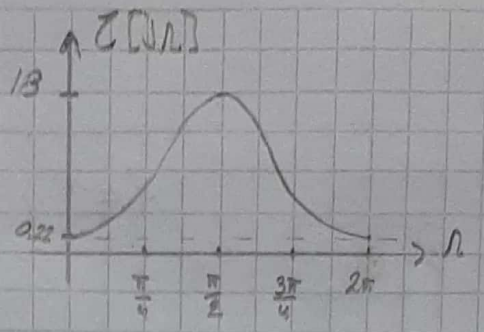


$$\tau = -\left.\frac{d\,H(z)}{dz}\right|_{z=e^{j\Omega}} = -0,8\,\frac{[2z(z^2+0,8) - (z^2+1,25)2z]}{(z^2+0,8)^2}$$

$$\tau = -0,8\,\frac{(2z^3 + z1,6 - 2z^3 - 2,5z)}{(z^2+0,8)^2} = \frac{0,72z}{(z^2+0,8)^2}$$

NOTA 22:30 → 23:00 13:10

$$T(j\Omega) = \frac{0{,}72\, e^{j\Omega}}{(e^{2j\Omega} + 0{,}8)^2}$$

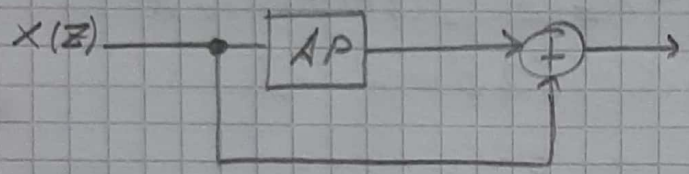


b)

$$H(z) = \alpha \frac{z^4 + 1/\alpha}{z^4 + \alpha}$$

hay que eliminar la frec de 125 Hz y su segundo armonico en 375 Hz

Se propone



Notch del doble de ganancia del AP

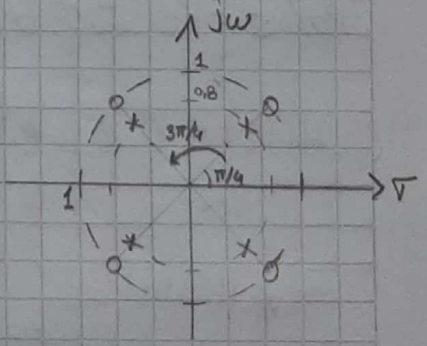
$$\frac{Y(z)}{X(z)} = \alpha \frac{(z^4 + 1/\alpha)}{z^4 + \alpha} + 1 = \frac{\alpha(z^4 + 1/\alpha) + z^4 + \alpha}{z^4 + \alpha}$$

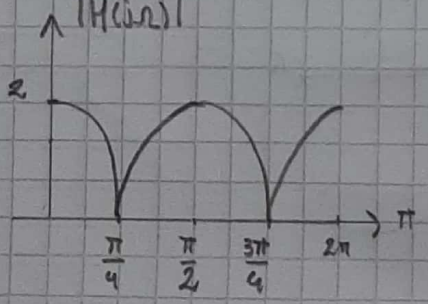
$$H(z) = \frac{z^4(1+\alpha) + (1+\alpha)}{z^4 + \alpha} = (1+\alpha)\frac{(z^4+1)}{z^4+\alpha}$$

ceros $z^4 = -1 \Rightarrow z_c = 1\, e^{j\left(\frac{\pi + k\pi}{4}\right)}$

El valor del α va a determinar la selectividad del filtro

Propongo $\alpha = 0{,}8 \Rightarrow z_p = 0{,}8\, e^{j\left(\frac{\pi + k\pi}{4}\right)}$





$\pi/4 \longrightarrow 125\,Hz$

$\pi \longrightarrow f_{s/2}$

$\Rightarrow f_{s/2} = 500\,Hz \Rightarrow f_s = 1000\,Hz$