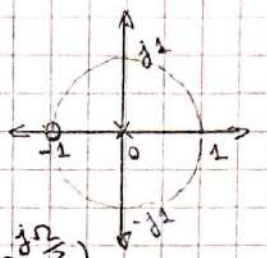
Ej 3 - GTP 5

a) Filtro de Media Móvil

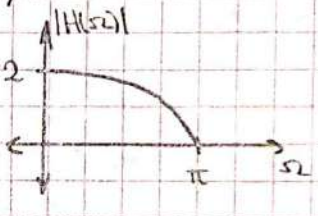
$h_1(k) = [1, 1]$ y $h_2(k) = [1, 1, 1]$

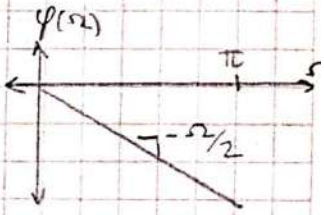
$H_1(z) = 1 + z^{-1} = \frac{z+1}{z}$



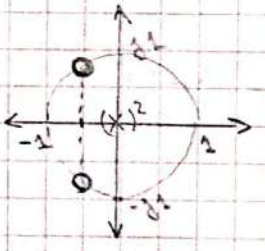
$H(\Omega) = e^{j0} + e^{-j\Omega} = e^{\frac{-j\Omega}{2}} \left(e^{\frac{-j\Omega}{2}} + e^{\frac{j\Omega}{2}}\right)$

$H(\Omega) = \underbrace{2 \cdot \cos\left(\frac{\Omega}{2}\right)}_{\text{MÓDULO}} \cdot \underbrace{e^{-j\Omega/2}}_{\text{FASE}}$





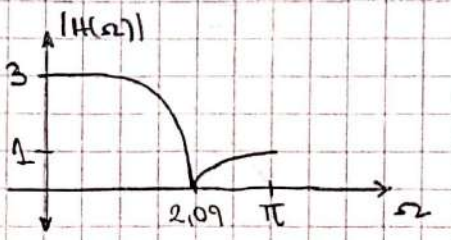
$h_2(k) \xrightarrow{\mathcal{Z}} H_2(z) = 1 + z^{-1} + z^{-2} = \frac{z^2 + z + 1}{z^2}$

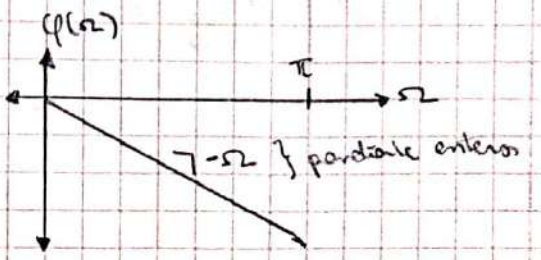


$H(\Omega) = e^{j0} + e^{-j\Omega} + e^{-j2\Omega}$

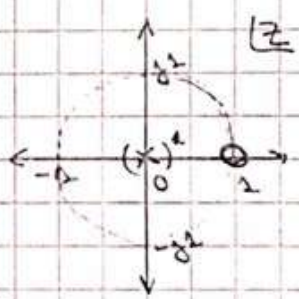
$H(\Omega) = e^{-j\Omega}\left(e^{j\Omega} + 1 + e^{-j\Omega}\right)$

$H(\Omega) = [1 + 2\cos(\Omega)]\, e^{-j\Omega}$





Ej 3 GTPS



b) $h_1(k) = [1, -1]$

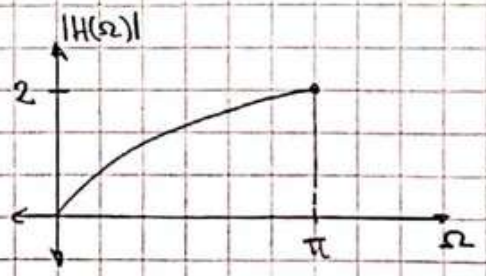
$\downarrow$

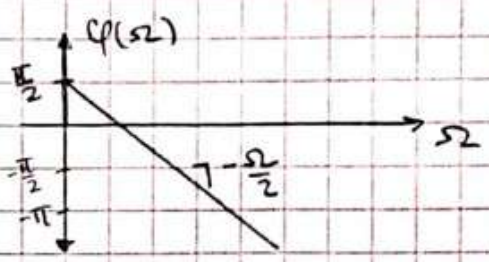
$H_1(z) = 1 - z^{-1} = \frac{z-1}{z}$

$\downarrow$

$H(\Omega) = e^{j0} - e^{-j\Omega} = e^{-j\frac{\Omega}{2}} \left[e^{j\frac{\Omega}{2}} - e^{-j\frac{\Omega}{2}} \right]$

$H(\Omega) = 2j \operatorname{sen}\left(\frac{\Omega}{2}\right) e^{-j\frac{\Omega}{2}} = 2 \cdot \operatorname{sen}\left(\frac{\Omega}{2}\right) \cdot e^{-j\frac{\Omega}{2} + \frac{\pi}{2}}$





$h_2(k) = [1, 0, -1]$

$\downarrow$

$H_2(z) = 1 - z^{-2} = \frac{z^2 - 1}{z^2}$

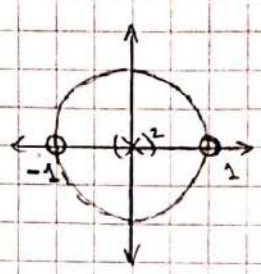
$\downarrow$

$H_2(\Omega) = e^{j0} - e^{-j\Omega 2}$

$H_2(\Omega) = e^{-j\Omega}\left(e^{j\Omega} - e^{-j\Omega}\right)$

$H_2(\Omega) = e^{-j\Omega} \cdot 2j \cdot \text{sen}(\Omega)$

$H_2(\Omega) = 2 \cdot \text{sen}(\Omega)\ e^{-j\Omega + \pi/2}$



• Mismo modulo queral de 1er orden → la fase tendría una pendiente mayor, de Ω a diferencia de la original de $\Omega/2$

Pregunta b. 2) $2 \cdot \text{sen}(\Omega) = \Omega \cdot 0{,}95$

$\frac{\text{sen}\,\Omega}{\Omega} = \frac{0{,}95}{2} = 0{,}475$

$\Omega \cong 1{,}9532$

si $\pi = \frac{f_s}{2}$

$1{,}9532 \cdot \frac{f_s}{2} \cdot \frac{1}{\pi}$

$\star\ \left[f_f = 0{,}31 \cdot f_s\right]$