Daniel López Ojea
Jordan Oreiro Vieites

HAE - Tarea 4

①

a) $x_1(t) = 2\cos(t + \pi/6) \rightarrow \omega_1 = 1$ rad/s

$$H(\omega) = \frac{1}{1 + j\omega CR} \rightarrow \begin{cases} |H(\omega)| = \dfrac{1}{\sqrt{1 + (\omega CR)}} \\ \underline{|H(\omega)} = -\text{arctg}(\omega CR) \end{cases}$$

$y_1(t) = |H(\omega_1)|\, 2\cos[t + \pi/6 + \underline{|H(\omega)}]$

$C = 100nF = 100 \cdot 10^{-9} = 10^{-7} F$

$R = 10k\Omega = 10 \cdot 10^3 = 10^4 \Omega$

b) $\omega_2 = 10^7$ rad/s

$y_2(t) = |H(\omega_2)| \cdot 4 \cdot \text{sen}[10^7 \cdot t + \pi/2 + \underline{|H(\omega_2)}]$

c) $\omega_1 = 1$ rad/s

d) $\omega_2 = 10^7$ rad/s

e) Tienen la misma frecuencia los dos.

f) $x_3(t) = 5 \cdot \text{sen}(0t + \pi/2) = 5$

$y_3(t) = |H(\omega)| \cdot 5 = 5$

②

$x(t) = \text{sen}(10^3 t) + \cos(10^6 t) \rightarrow y(t) = y_1(t) + y_2(t)$

$y_1(t) = |H(\omega)|\, \text{sen}(10^3 t + \underline{|H(\omega)}) = \frac{1}{\sqrt{2}} \cdot \text{sen}(10^3 t + (-\pi/4))$

$\underline{|H(\omega)} = -\text{arctg}(10^3 \cdot 10^{-7} \cdot 10^4) = \text{arctg}(1) = -\pi/4$

$$|H(\omega)| = \frac{1}{\sqrt{1 + (10^3 \cdot 10^{-7} \cdot 10^4)^2}} = \frac{1}{\sqrt{2}}$$

$y_2(t) = 10^{-3} \cos(10^6 t - 5'67)$

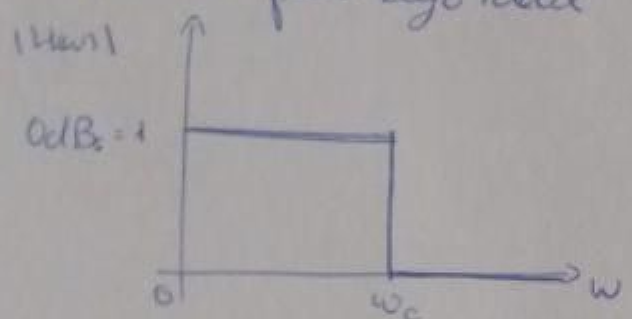
$\underline{|H(\omega)} = -\text{arctg}(10^6 \cdot 10^{-7} \cdot 10^4) = -\text{arctg}(10^3) = 5'67$

$$|H(\omega)| = \frac{1}{\sqrt{1 + (10^6 \cdot 10^{-7} \cdot 10^4)^2}} = \frac{1}{\sqrt{1 + 10^6}} = 10^{-3}$$

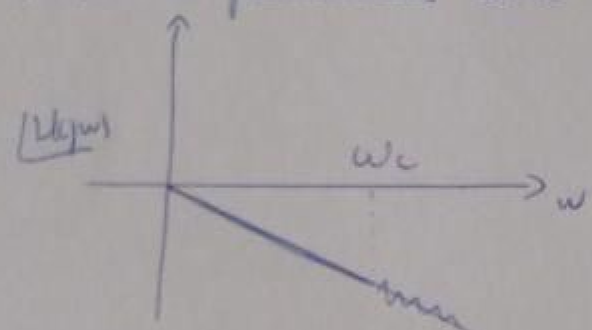
③ a) Será la misma señal pero con un desfase de $-\pi$ radianes

b)

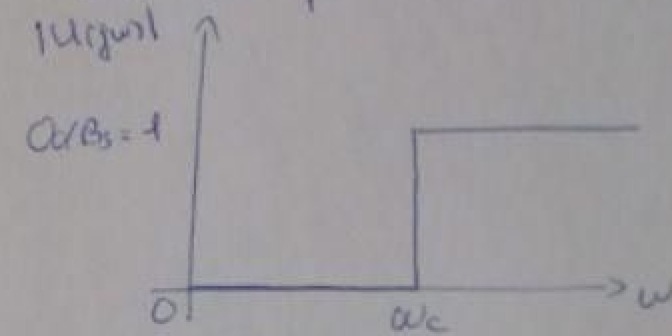
1. Filtro paso bajo ideal



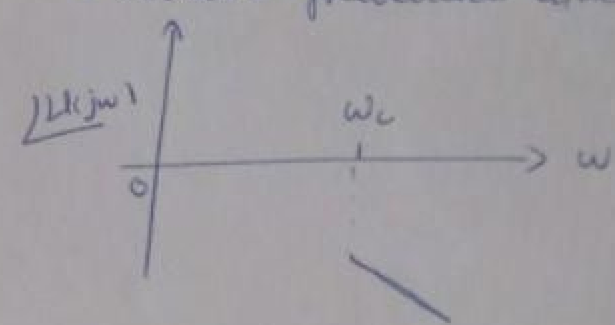
• Admite frecuencias entre 0 y ω_c



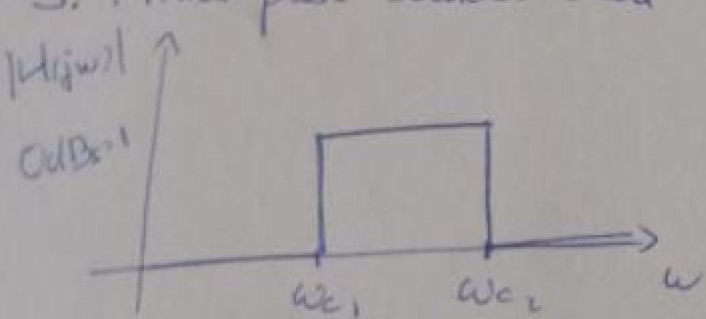
2. Filtro paso alto ideal



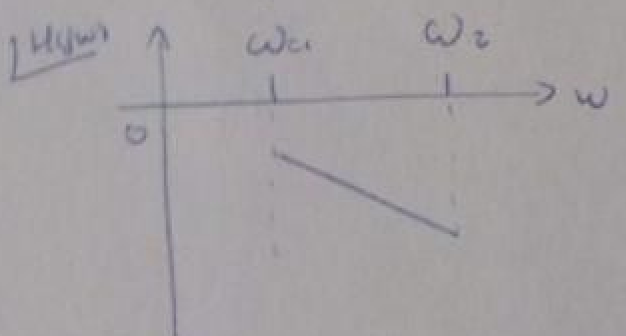
• Admite frecuencias entre ω_c y ω



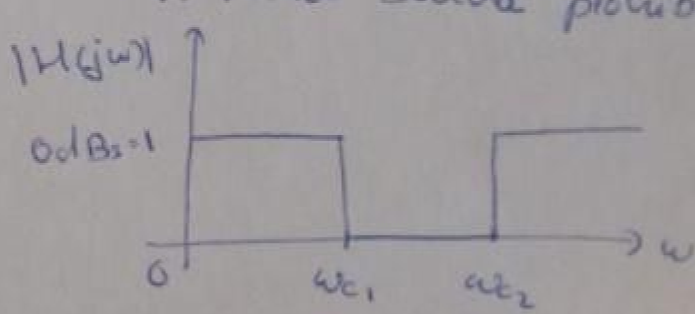
3. Filtro paso banda ideal



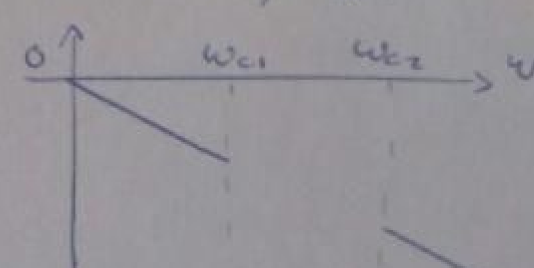
• Admite frecuencias entre ω_{c1} y ω_{c2}



4. Filtro banda prohibida ideal



• Admite frecuencias entre 0, ω_{c1} y ω_{c2} y ω.



(4)
a) Tiene la misma amplitud y la fase varía linealmente con la frecuencia.
b) Tiene que variar linealmente con la frecuencia en la banda de paso.
c) No porque la amplitud será 0.

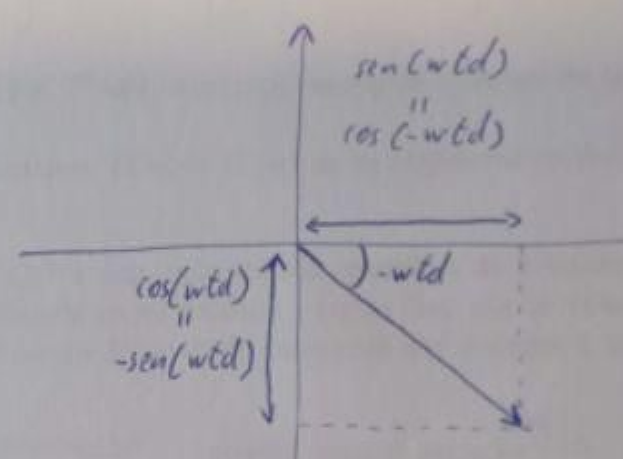
(5)
a) $y(t) = A_0 \cdot \cos(\omega_0 t + \theta_0 - \omega t_d) + A_1 \,\text{sen}\,(\omega_1 t + \theta - \omega t_d)$

b) $y(t) = A_0 \cos(\omega_0 t + \theta_0 - k) + A_1 \,\text{sen}\,(\omega_1 t + \theta - k)$

~~(6) a)~~ $\cancel{y(t) = A_0 \cos(w_0 t + \theta_0 - wtd + A_1 \,\text{sen}\,(w_1 t + \theta_1 - wtd)}$

~~b)~~ $\cancel{y(t) = A_0 \cos(w_0 t + \theta_0 - K) + A_1 \,\text{sen}\,(w_1 t + \theta_1 - K)}$

(6)
$$H(w) = \begin{cases} e^{-jwtd} & -B \leq w \leq B \\ 0 & w < (-B),\ w > B \end{cases}$$

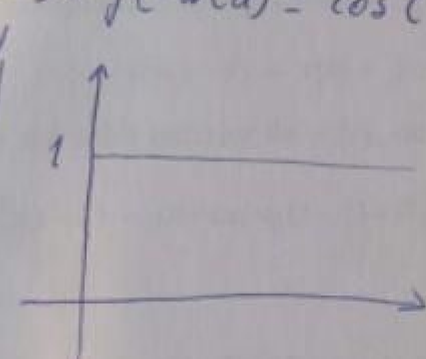


$$e^{-jwtd} = \cos(wtd) - j \cdot \text{sen}(wtd)$$
$$\overset{\shortparallel}{e^{-j\alpha}}, \quad \alpha = -wtd$$
$$e^{j\alpha} = \cos(\alpha) - j\,\text{sen}(\alpha) = \cos(-wtd) + j(-wtd) = \cos(wtd) - j\,\text{sen}(wtd)$$

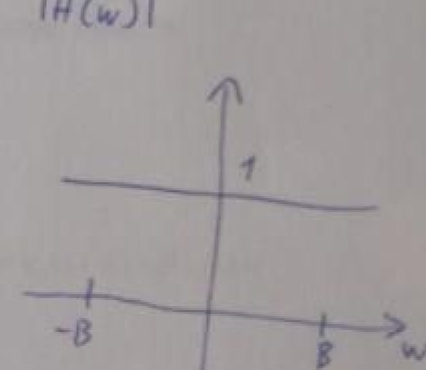
$|e^{-jwtd}| = 1 = cte$

$\angle e^{-jwtd} = -wtd$

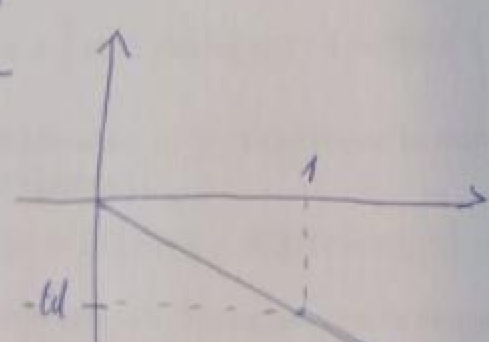
$|e^{-jwtd}|$

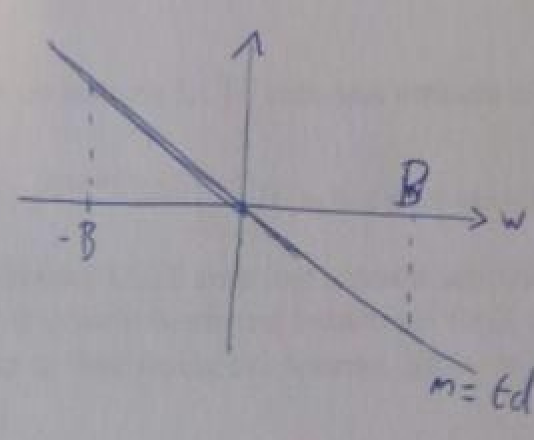


$|H(w)|$



$\angle e^{-jwtd}$





7 a) ~~Esta~~

$-w_a = 2\pi \cdot f_a = 2\pi \cdot 4 \cdot 10^3\, Hz = 8\pi \cdot 10^3\, rad/s$

$w_a < 0{,}5\, w_s \rightarrow w_s > 16\pi \cdot 10^3\, rad/s$

b) $f_a = \frac{16\pi \cdot 10^3}{2\pi} = 8 \cdot 10^3\, Hz$

$t = \frac{1}{8 \cdot 10^3} = 8 \cdot 10^{-3} = 8\, ms$