

①  $z(t) = x(t) + y(t)$

$$z(t) = u(t+2) - u(t+1) + 2u(t-1) - 2u(t-2) - 2u(t-2) + 2u(t-3)$$

$$z(t) = u(t+2) - u(t+1) + 2u(t-1) - 4u(t-2) + 2u(t-3)$$

Graficar  $w(t) = z(t) * r(2(t+k) - 6)$ , con  $k = 16$

$$z(t) * r(2t + 2k - 6), \text{ con } k = 16$$

$$z(t) * r(2t + 26)$$

$$\bullet E_{w-2} = (2 \cdot -2) + 26 = 22$$

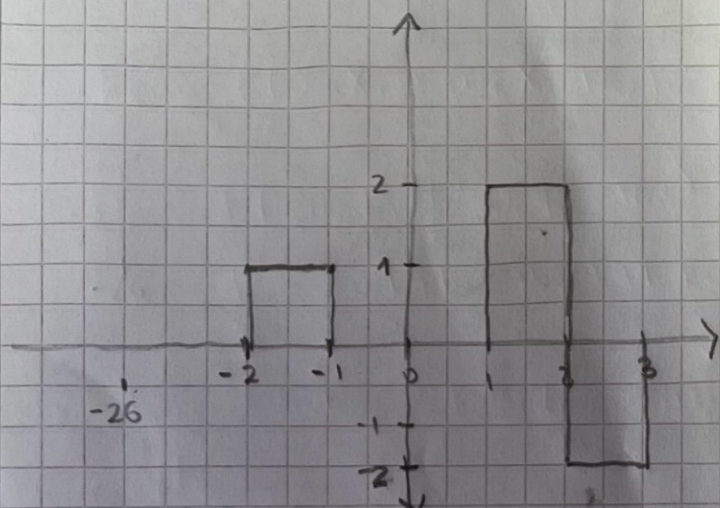
$$\bullet E_{w-1} = (2 \cdot -1) + 26 = 24$$

$$\bullet E_{w1} = [(2 \cdot -1) + 26] \cdot 2 = 56$$

$$\bullet E_{w2} = [(2 \cdot -2) + 26] \cdot 2 = 60$$

$$\bullet E_{w2} = [(2 \cdot 2) + 26] \cdot (-2) = -60$$

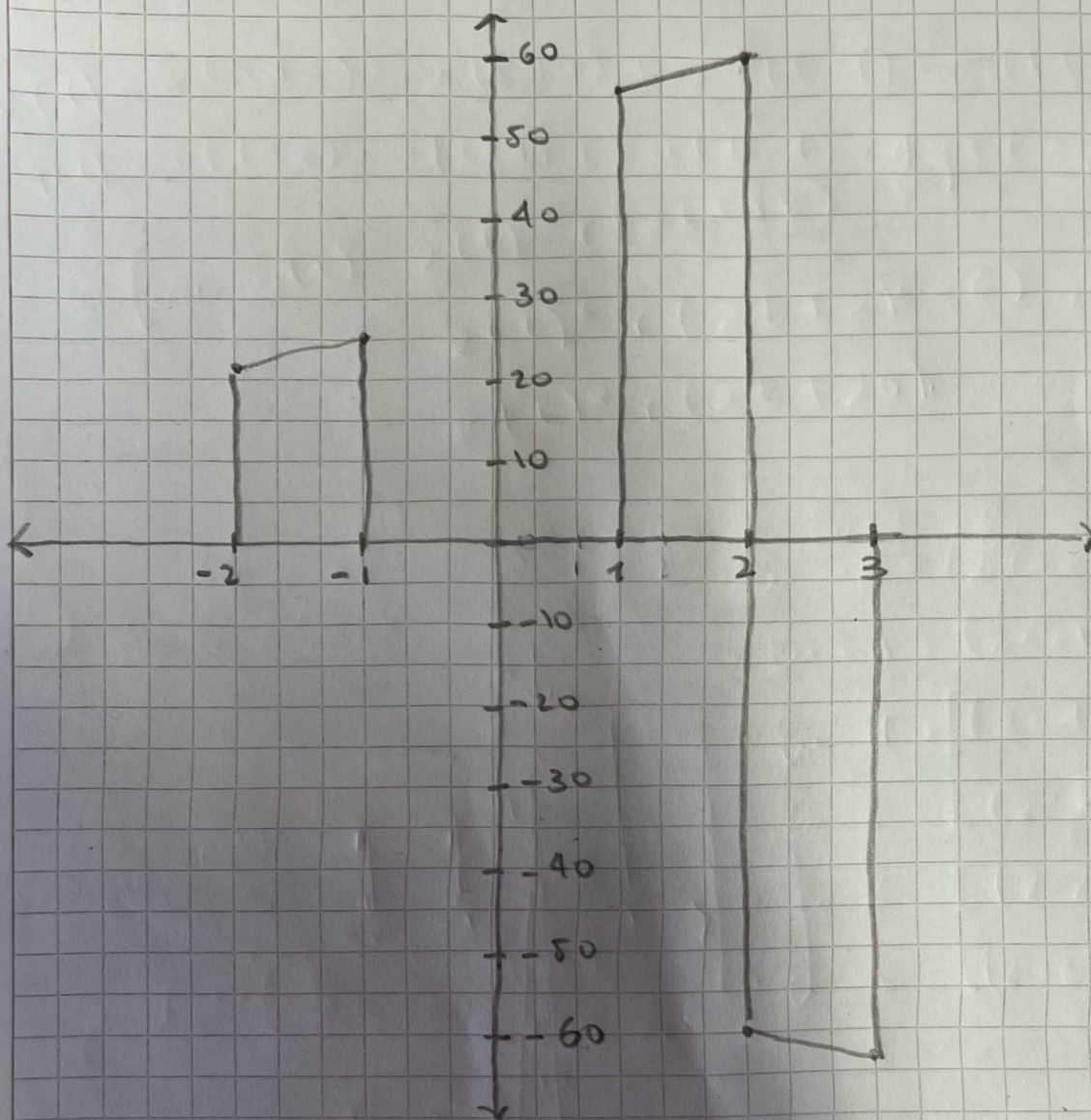
$$\bullet E_{w3} = [(2 \cdot 3) + 26] \cdot (-2) = -64$$



$$2(t+2) - 6$$

$$2t - 6$$







③. Encontrar la Transformada de Fourier.

Con  $K = 16$ .

$$x(t) = 4 \operatorname{Sen}(80\pi t + \pi/4) + K \operatorname{Cos}(40\pi t) + 5.$$

La transf. Fourier son operaciones lineales, entonces:

$$X_1 = 4 \operatorname{Sen}(80\pi t + \pi/4)$$

$$X_2 = K \cdot \operatorname{Cos}(40\pi t)$$

$$X_3 = 5.$$

✓ Para  $X_3(t) = 5 \cdot 1$ .

Se sabe que  $\mathcal{F}\{\delta(t)\} = 1$ .

$$\rightarrow \mathcal{F}\{1\} = 2\pi \delta(\omega)$$

$$\rightarrow \mathcal{F}\{5 \cdot 1\} = 10\pi \delta(\omega).$$

Por prop. Simetría-dualidad

$$\delta(t) \xleftrightarrow{\mathcal{F}} 1$$

$$1 \longleftrightarrow 2\pi \delta(-\omega)$$

$$= 2\pi \delta(\omega)$$

↓  
El impulso es par.

✓ Para  $X_1(t) =$

$$\mathcal{F}\{4 \operatorname{Sen}(80\pi t + \pi/4)\}$$

$$= 4 \mathcal{F}\{\operatorname{Sen}(80\pi t + \pi/4)\} = \frac{4}{2j} \mathcal{F}\{e^{j(80\pi t + \pi/4)} - e^{-j(80\pi t + \pi/4)}\}$$

$$= \frac{2}{j} \mathcal{F}\{e^{j80\pi t} e^{j\pi/4} - e^{-j80\pi t} e^{-j\pi/4}\}$$

$$= \frac{2}{j} \left( \mathcal{F}\{e^{j80\pi t} e^{j\pi/4} \cdot 1\} - \mathcal{F}\{e^{-j80\pi t} e^{-j\pi/4}\} \right).$$

$$= \frac{2}{j} \left( e^{j\pi/4} \underbrace{\mathcal{F}\{e^{j80\pi t} \cdot 1\}}_{\text{desplazamiento en frecuencia}} - e^{-j\pi/4} \underbrace{\mathcal{F}\{e^{-j80\pi t} \cdot 1\}}_{\text{desplazamiento en frecuencia}} \right).$$

$$= \frac{2}{j} \left( e^{j\pi/4} \cdot 2\pi \delta(\omega - 80\pi) - e^{-j\pi/4} \cdot 2\pi \delta(\omega + 80\pi) \right)$$

$$= -2j \left( e^{j\pi/4} \cdot 2\pi \delta(\omega - 80\pi) - e^{-j\pi/4} \cdot 2\pi \delta(\omega + 80\pi) \right).$$



• Para  $x_2(t) = K \cos(40\pi t)$   $\cos(\theta) = \frac{1}{2}(e^{j\theta} + e^{-j\theta})$

→  $\frac{K}{2}(e^{40\pi jt} + e^{-40\pi jt})$

→  $\frac{K}{2}(\mathcal{F}\{e^{40\pi jt}\} + \mathcal{F}\{e^{-40\pi jt}\})$

Desplazamiento en frecuencias

•  $\frac{K}{2}(2\pi \delta(\omega - 40\pi) + 2\pi \delta(\omega + 40\pi))$

Entonces, la transformada total es:

$10\pi \delta(\omega) - 2j(e^{j\frac{\pi}{4}} \cdot 2\pi \delta(\omega - 80\pi) - e^{-j\frac{\pi}{4}} \cdot 2\pi \delta(\omega + 80\pi))$

$+ 8(2\pi \delta(\omega - 40\pi) + 2\pi \delta(\omega + 40\pi))$



Señal fisiológica definida entre  $10\text{Hz}$  y  $55\text{Hz}$  se toma con  $f_s = 100\text{Hz}$ .

a) Filtro pasa altas.  $f_c = 10\text{Hz}$

$$\text{Salida} = \frac{\text{Entrada}}{10} \quad A_{\text{out}} = \frac{A_{\text{in}}}{10}$$

$$20 \log \left( \frac{A_{\text{out}}}{A_{\text{in}}} \right) = 20 \log \left( \frac{\frac{A_{\text{in}}}{10}}{A_{\text{in}}} \right) = 20 \log \left( \frac{1}{10} \right) = -20\text{dB}$$

$$f_{\text{c normal}} = \frac{10\text{Hz}}{100\text{Hz}} = 0.1\text{Hz}$$

Ventana rectangular que atenúa  $-20\text{dB}$

$$\rightarrow 0.1 = \frac{0.9}{m} \rightarrow m = \frac{0.9}{0.1} = 9$$

Rectangular la  
Ventana es 1

$$[-4, 4]$$

$$0 \leq n \leq N-1$$

$$b[0] = 2\pi(0.1) = 0.6283$$

$$b[m] = \frac{\sin(2\pi f_c m)}{m}$$

$$\begin{aligned} b[-4] &= 0.1469 & b[-2] &= 0.4755 & b[1] &= 0.5877 & b[3] &= 0.3170 \\ b[-3] &= 0.3170 & b[-1] &= 0.5877 & b[2] &= 0.4755 & b[4] &= 0.1469 \end{aligned}$$

$m$	-4	-3	-2	-1	0	1	2	3	4
$b$	0.1469	0.3170	0.4755	0.5877	0.6283	0.5877	0.4755	0.3170	0.1469
$w$	1	1	1	1	1	1	1	1	1
$\delta$	0	0	0	0	1	0	0	0	0

$$w_{\text{HPF}} = [-0.1469, -0.3170, -0.4755, -0.5877, 0.3170, 0.5877, 0.4755, 0.3170, 0.1469]$$



b) Pasa bajas  $f_c = 50 \text{ Hz}$ .

$$f_{c \text{ normal}} = \frac{50 \text{ Hz}}{100 \text{ Hz}} = 0.5.$$

$$20 \log \left( \frac{A_m/100}{A_m} \right) = 20 \log \left( \frac{1}{100} \right) = -40 \text{ dB}$$

Puedo usar Hamming  
atenuar a  $-53 \text{ dB}$ .

$$\Delta T = \frac{3.1}{m}$$

$$m = \frac{3.3}{0.5} = 6.6 \approx 7 \text{ } [-3, 3].$$

$$0.54 - 0.46 \cos \left( \frac{2\pi n}{M-1} \right)$$

$$0 \leq n \leq M-1$$

$$b[0] = 2\pi f_c = \pi$$

$$b[m] = \frac{\sin(2\pi f_c m)}{m} \quad \text{en } m \text{ } [-3, 3].$$

$$b[-3] = 0 \quad b[0] = \pi \quad b[3] = 0.$$

$$b[-2] = 0 \quad b[1] = 0$$

$$b[-1] = 0 \quad b[2] = 0$$

m	-3	-2	-1	0	1	2	3
b	0	0	0	$\pi$	0	0	0
w	0.08	0.31	0.77	1	0.77	0.31	0.08
hfft	0	0	0	$\pi$	0	0	0