INSTITUTO POLITÉCNICO NACIONAL

ESCUELA SUPERIOR DE CÓMPUTO

Espectro de Frecuencias

Participación 1.5

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Teoría de Comunicaciones y Señales

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3CV17

Fecha:

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$$h(t)=\begin{cases}-10 & -8<t<-4\\ 5/2t & -4<t<4\\ 10 & 4<t<8\end{cases}$$

$$h(t)=\sum_{n=-\infty}^{\infty} C_n e^{jn\frac{\pi}{8}t}$$

$$C_n=\frac{1}{T}\int_{to}^{to+T} h(t)\,e^{-jn\omega_0 t}\,dt$$

$T=16$

$$\omega_0=\frac{2\pi}{T}=\frac{2\pi}{16}=\frac{\pi}{8}$$

entonces;

$$C_n=\frac{1}{16}\int_{-8}^{8} h(t)\,e^{-jn\omega_0 t}\,dt=\frac{1}{16}\left[\int_{-8}^{-4}(-10)e^{-jn\frac{\pi}{8}t}\,dt+\int_{-4}^{4}\frac{5}{2}te^{-jn\frac{\pi}{8}t}dt\right.$$

$$\left.+\int_{4}^{8}(0)e^{-j\frac{n\pi}{8}t}\,dt\right]=\left[\left(\frac{-5}{8}\right)\left(\frac{-8}{jn\pi}\right)e^{-jn\pi\frac{t}{8}}\right]\Bigg|_{-8}^{-4}+\frac{5}{32}\left[\frac{-8t}{jn\pi}e^{-jn\frac{\pi}{8}}\right]\Bigg|_{-4}^{4}$$

$$+\frac{8}{jn\pi}\int_{-4}^{4}e^{-jn\frac{\pi}{8}t}\,dt-\frac{5}{jn\pi}\left(e^{-jn\pi}-e^{-jn\frac{\pi}{2}}\right)$$

$$=\frac{5}{jn\pi}e^{\frac{jn\pi}{2}}-\frac{5}{jn\pi}e^{jn\pi}+\frac{5}{32}\left\{\frac{-32}{jn\pi}e^{-jn\frac{\pi}{2}}-\frac{32}{jn\pi}e^{\frac{jn\pi}{2}}-\frac{64}{j^2n^2\pi}e^{\frac{-jn\pi}{8}}\right\}\Bigg|_{-4}^{4}$$

$$\frac{-5}{jn\pi}e^{-jn\pi}+\frac{5}{jn\pi}e^{\frac{-jn\pi}{2}}=\frac{5}{jn\pi}e^{\frac{2n\pi}{4}}-\frac{5}{jn\pi}e^{jn\pi}-\frac{5}{jn\pi}e^{\frac{-jn\pi}{2}}-\frac{5}{jn\pi}e^{\frac{jn\pi}{2}}$$

$$+\frac{5}{jn\pi}e^{\frac{-jn\pi}{2}}=\frac{5}{jn\pi}e^{\frac{jn\pi}{2}}-\frac{5}{jn\pi}e^{jn\pi}-\frac{5}{jn\pi}e^{\frac{-jn\pi}{2}}-\frac{5}{jn\pi}e^{\frac{jn\pi}{2}}+\frac{10}{n^2\pi^2}\left[e^{\frac{-jn\pi}{2}}-e^{\frac{jn\pi}{2}}\right]$$

$$-\frac{5}{jn\pi}e^{-jn\pi}+\frac{5}{jn\pi}e^{\frac{-jn\pi}{2}}$$

$$=-\frac{5}{jn\pi}\left(e^{jn\pi}+e^{-jn\pi}\right)-\frac{10}{n^2\pi^2}\left[e^{\frac{jn\pi}{2}}-e^{-\frac{jn\pi}{2}}\right]=\frac{-5(2)}{jn\pi}\frac{e^{jn\pi}+e^{-jn\pi}}{2}$$

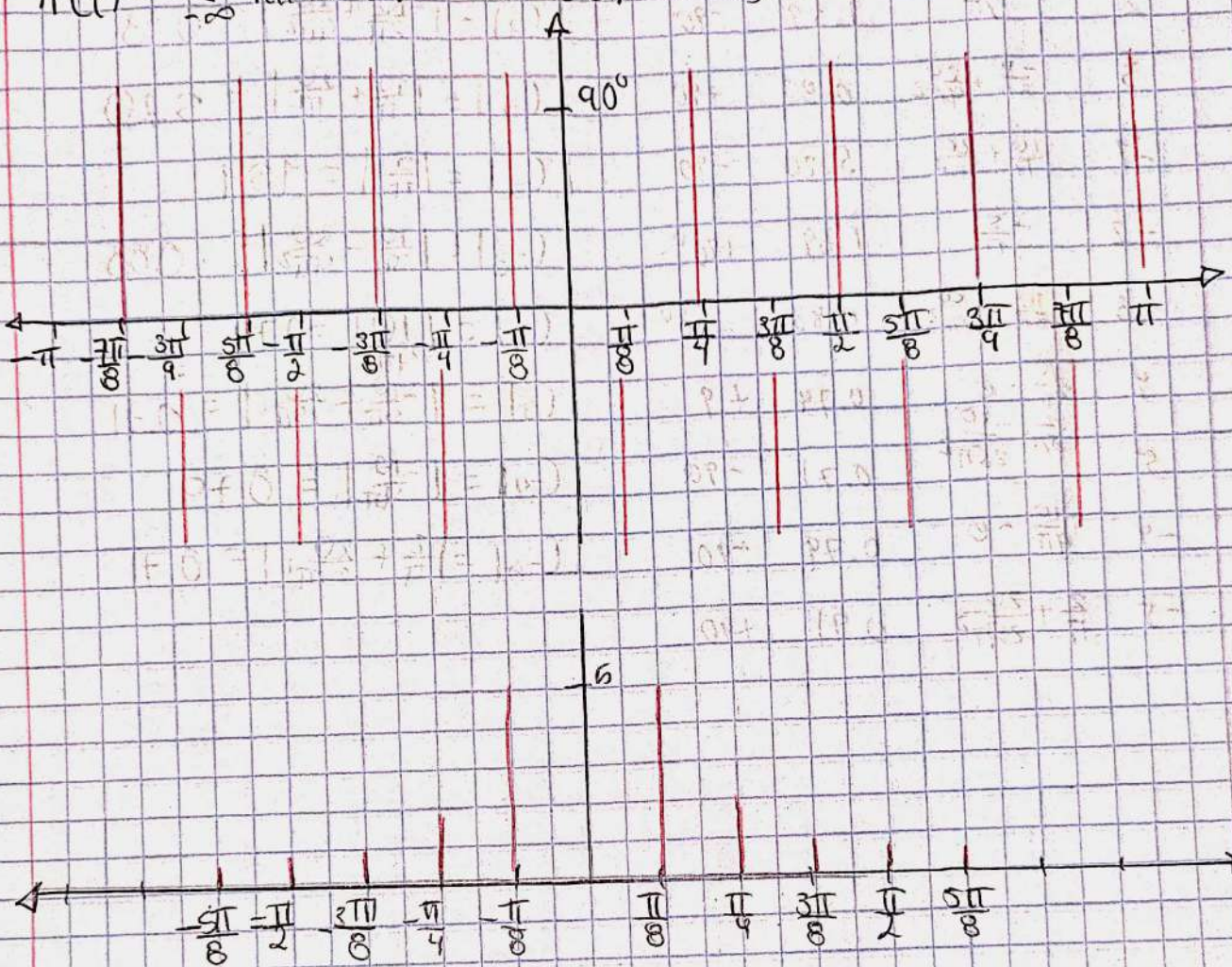
$$\frac{-20j}{n^2\pi^2}\left[\frac{e^{\frac{jn\pi}{2}}-e^{-\frac{jn\pi}{2}}}{2j}\right]=\frac{-10}{jn\pi}\cos(n\pi)^{(-1)^n}-\frac{20j}{n^2\pi^2}\operatorname{Sen}\left(\frac{n\pi}{2}\right)$$

$$C_n=\left[\frac{-10}{jn\pi}(-1)^n-\frac{20}{n^2\pi^2}\right]\operatorname{sen}\left(\frac{n\pi}{2}\right)\Big]\quad\forall\, n\neq 0$$

$$C_0=\frac{1}{16}\int_{-8}^{8}h(t)\,dt=0.$$

$C_0 = \frac{1}{16}\int_{-8}^{8} h(t)\,dt = \emptyset$, tendiendo a $C_n = \frac{10j}{n\pi}\left[(-1)^n - \frac{2}{n\pi}\operatorname{sen}\left(\frac{n\pi}{2}\right)\right]$

$h(t) = \sum_{-\infty}^{\infty} \frac{10j}{n\pi}\left[(-1)^n - \frac{2}{n\pi}\operatorname{sen}\left(\frac{n\pi}{2}\right)\right] e^{\frac{jn\pi t}{8}}$, $\omega_0 = \frac{\pi}{8}$



$C_n = j\left[\frac{10}{n\pi}(-1)^n - \frac{20}{n^2\pi^2}\operatorname{sen}\left(\frac{n\pi}{2}\right)\right] \rightarrow C = \emptyset + 4j \rightarrow |C| = \sqrt{\emptyset^2 + 4^2} = \sqrt{4^2} = |4|$

$|C_n| = \left|\frac{10}{n\pi}(-1)^n - \frac{20}{n^2\pi^2}\operatorname{sen}\frac{n\pi}{2}\right|$; $\theta = \tan^{-1}\left(\frac{\text{img}}{\text{real}}\right)$

$\theta = \tan^{-1}(y) = 90°$ si $y > 0$

$y = \left(\frac{10}{n\pi}(-1)^n - \frac{20}{n^2\pi^2}\operatorname{sen}\left(\frac{n\pi}{2}\right)\right)$

$\theta = -90°$ si $y < 0$

0	0	0	0
1	$-\frac{10}{n}-\frac{20}{n^2}$	5.20	π
2	$5/\pi$	1.59	-90
3	$\frac{-10}{3\pi}+\frac{20}{9\pi^2}$	0.83	$+90$
-1	$\frac{10}{\pi}+\frac{20}{\pi^2}$	5.20	-90
-2	$-\frac{5}{\pi}$	1.59	180°
-3	$\frac{10}{3\pi}-\frac{20}{9\pi^2}$	0.83	-90°
4	$\frac{10}{4\pi}-\pi$	0.79	$+\pi$
5	$\frac{2}{\pi}\frac{-20}{25\pi^2}$	0.71	-90
-4	$\frac{-10}{4\pi}-\pi$	0.79	-90
-5	$\frac{2}{\pi}+\frac{20}{25\pi^2}$	0.71	$+90$

$|C_1| = |-\frac{10}{\pi}-\frac{20}{\pi^2}| = 5.20$

$|C_2| = |\frac{5}{\pi}| = 1.59$

$|C_3| = |-\frac{10}{3\pi}+\frac{20}{9\pi^2}| = 0.83$

$|C_{-1}| = |\frac{10}{\pi}+\frac{20}{\pi^2}| = 5.20$

$|C_{-2}| = |\frac{5}{\pi}| = 1.59$

$|C_{-3}| = |\frac{10}{3\pi}-\frac{20}{9\pi^2}| = .083$

$|C_4| = |\frac{10}{4\pi}| = 0.79$

$|C_5| = |\frac{-10}{5\pi}-\frac{20}{25\pi^2}| = 0.71$

$|C_{-4}| = |\frac{-10}{4\pi}| = 0.79$

$|C_{-5}| = |\frac{2}{\pi}+\frac{20}{25\pi^2}| = 0.71$