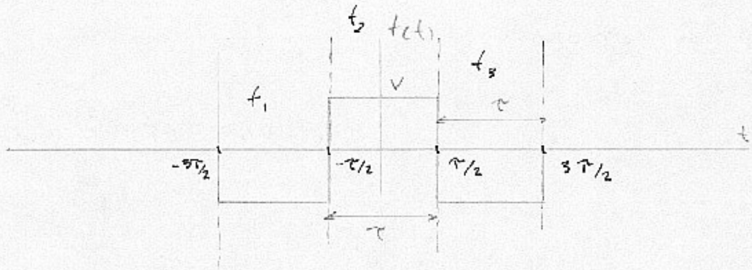
Eduardo Lanchares Pulido 2º ITIS Grupo B 22/02/06

Apartado 1:



$f(t) = f_1(t) + f_2(t) + f_3(t)$

La integral de Fourier de la función f:

$$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-j\omega t}\, dt$$

$$F(\omega) = F_1(\omega) + F_2(\omega) + F_3(\omega)$$

$$F(\omega) = \int_{-3\tau/2}^{-\tau/2} f(t)\, e^{-j\omega t}\, dt + \int_{-\tau/2}^{\tau/2} f(t)\, e^{-j\omega t}\, dt + \int_{\tau/2}^{3\tau/2} f(t)\, e^{-j\omega t}\, dt$$

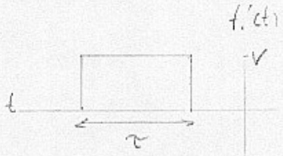
Como sabemos:

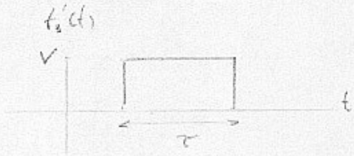
$$\int_{-\tau/2}^{\tau/2} f(t)\, e^{-j\omega t}\, dt = V \cdot \tau \cdot \frac{\operatorname{sen}(\omega \tau/2)}{\omega \tau/2}$$

también:

$f(t) = -f_1'(t) + f_2(t) - f_3'(t)$

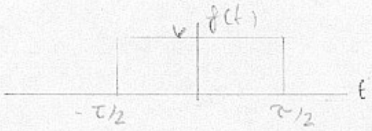
Siendo:





Para calcular $F_1(w)$ y $F_3(w)$ aplicamos el teorema de desplazamiento en tiempo:

Si $f(t)$ se corresponde con:



$$F(w) = V \cdot \tau \cdot \frac{sen\,(w\tau/2)}{w\tau/2}$$

Entonces:

$$f_1'(t) = f(t+\tau) \Rightarrow F_1(w) = -F(w) \cdot e^{+jw\tau}$$

$$F_1(w) = -V \cdot \tau \cdot \frac{sen\,(w\tau/2)}{w\tau/2} \cdot e^{+jw\tau}$$

Análogamente:

$$f_3'(t) = f(t-\tau) \Rightarrow F_3(w) = -F(w) \cdot e^{-jw\tau}$$

$$F_3(w) = -V \cdot \tau \cdot \frac{sen\,(w\tau/2)}{w\tau/2} \cdot e^{-jw\tau}$$

Finalmente:

$$e^{\phi i} = \cos(\phi) + sen\,(\phi)\,j$$

$$e^{jw\tau} = \cos(w\tau) + sen\,(w\tau)\,j$$

$$e^{-jw\tau} = \cos(w\tau) - sen\,(w\tau)\,j$$

$$F(w) = F_1(w) + F_2(w) + F_3(w)$$

$$F(w) = -F(w) \cdot (\cos(w\tau) + sen\,(w\tau)\,j) + F(w)$$
$$- F(w) \cdot (\cos(w\tau) - sen\,(w\tau)\,j)$$

$$F(w) = F(w) \cdot (-2\cos(w\tau))$$

$$F(w) = V \cdot \tau \cdot \frac{sen\,(w \cdot \tau/2)}{w\tau/2} \cdot (-2\cos(w\tau))$$

$$F(w) = -2V\tau \cdot \frac{sen\,(w\tau/2)\cos(w\tau)}{w\tau/2}$$

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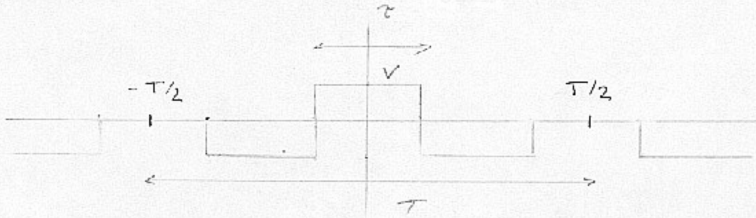
Apartado 2:



$T = 4\tau$

$$F(w) = -2V\cdot\tau \cdot \frac{sen(w\tau/2)\cos(w\tau)}{w\,\tau/2}$$

$F(w) \longrightarrow C_n$

$w \longrightarrow w_n$

$$w_n = \frac{2\pi}{T}\cdot n = \frac{2\pi}{4\tau}\cdot n = \frac{\pi}{2\tau}\cdot n$$

$$C_n = -2V\cdot\tau\cdot\frac{sen(w_n\tau/2)\cos(w_n\tau)}{w_n\,\tau/2}$$

$$C_n = -2V\cdot\tau\cdot\frac{sen(\frac{\pi}{2\tau}\cdot n\cdot\tau/2)\cdot\cos(\frac{\pi}{2\tau}\cdot n\cdot\tau)}{\pi/2\tau\cdot n\cdot\tau/2}$$

$$C_n = -2V\cdot\tau\cdot\frac{sen(\frac{n\pi}{4})\cdot\cos(\frac{\pi}{2}n)}{n\,\pi/4}$$

Cálculo de los 6 primeros coeficientes:

$$C_0 = -2V\cdot\tau\cdot\frac{sen(\frac{0\cdot\pi}{4})\cdot\overbrace{\cos(\frac{\pi}{2}\cdot 0)}^{1}}{0\cdot\pi/4} = -2V\cdot\tau$$

$$C_1 = -2\cdot V\cdot\tau\cdot\overbrace{\cos(\frac{\pi}{2})}^{0}\cdot\frac{sen(\pi/4)}{\pi/4} = 0$$

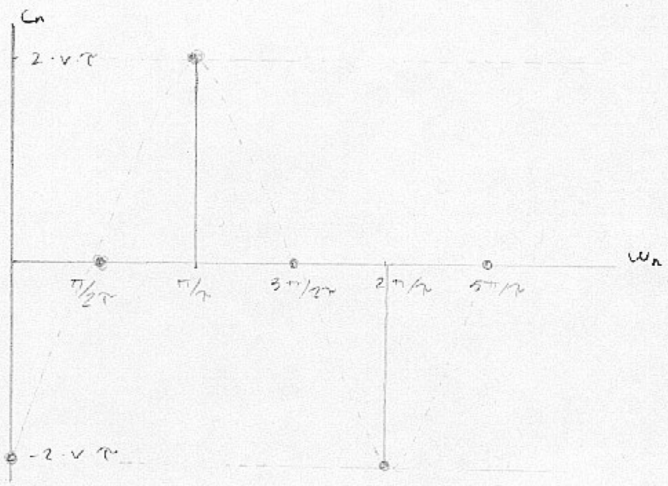
$$C_2 = -2\cdot V\cdot\tau\cdot\cos(\pi)\cdot sen(\pi/2) = +2V\tau$$

$$C_3 = -2\cdot V\cdot\tau\cdot\overbrace{\cos(\frac{3\pi}{2})}^{0}\cdot\frac{sen(\frac{3\pi}{4})}{3\pi/4} = 0$$

$$C_4 = -2 \cdot V \cdot \tau \cdot \cos(2\pi) \quad \cancelto{1}{\operatorname{sen}(\pi)/\pi} = -2 V \cdot \tau$$

$$C_5 = -2 \cdot V \cdot \tau \cdot \cos\left(\cancelto{0}{\tfrac{5\pi}{2}}\right) \quad \frac{\operatorname{sen}\left(\frac{5\pi}{4}\right)}{5\pi/4} = 0$$

Representación gráfica:



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