Le14

Tuesday, 4 April 2023 22:25

Es 1c

$s(t) = \cos(\omega_0 t + \varphi_0)$ $\omega_0 = 2\pi/T_p$

$S_k = ?$

$m_s = ?$

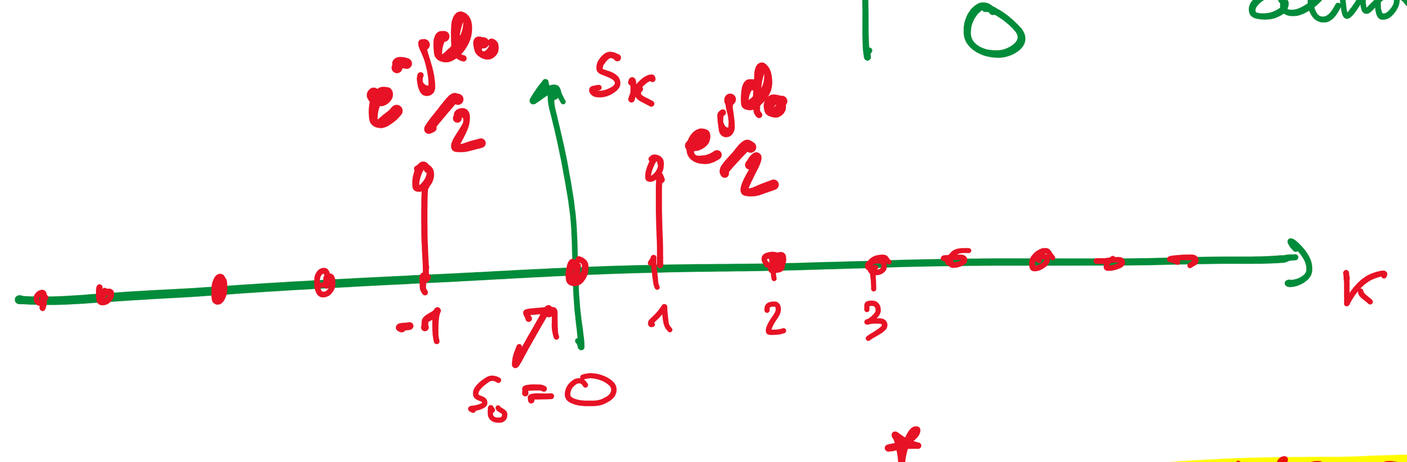
$P_s = ?$

$$s(t) = \frac{e^{j\varphi_0}}{2} e^{j\omega_0 t} + \frac{e^{-j\varphi_0}}{2} e^{-j\omega_0 t}$$

(S_1, $k=1$; S_{-1}, $k=-1$) PER ISPEZIONE

$$s(t) = \sum_{k=-\infty}^{+\infty} S_k e^{jk\omega_0 t}$$

$$S_k = \begin{cases} e^{j\varphi_0}/2 & k=1 \\ e^{-j\varphi_0}/2 & k=-1 \\ 0 & \text{altrove} \end{cases}$$



$S_{-1} = S_1^*$ SIMM. HERMITIANA

$m_s = S_0 = 0$

$$P_s = \sum_k |S_k|^2 = |S_1|^2 + |S_{-1}|^2 = \frac{1}{4} + \frac{1}{4} = \frac{1}{2}$$

Es

$$x(t) = 3 - \sin(2t) + 4\cos(2t) + 2\cos(6t - \pi/4)$$

(puls. 0 → $0\cdot\omega_0$; $\omega_0 = 2$; ω_0; $3\omega_0$)

$X_k = ?$

$$x(t) = 3\cdot e^{j0\cdot\omega_0 t} + \left(\frac{e^{j\omega_0 t} - e^{-j\omega_0 t}}{2j}\right)\cdot + j + 2\left(\frac{e^{j\omega_0 t} + e^{-j\omega_0 t}}{2}\right) + 2\,\frac{e^{j3\omega_0 t} e^{-j\pi/4} + e^{-j3\omega_0 t} e^{j\pi/4}}{2}$$

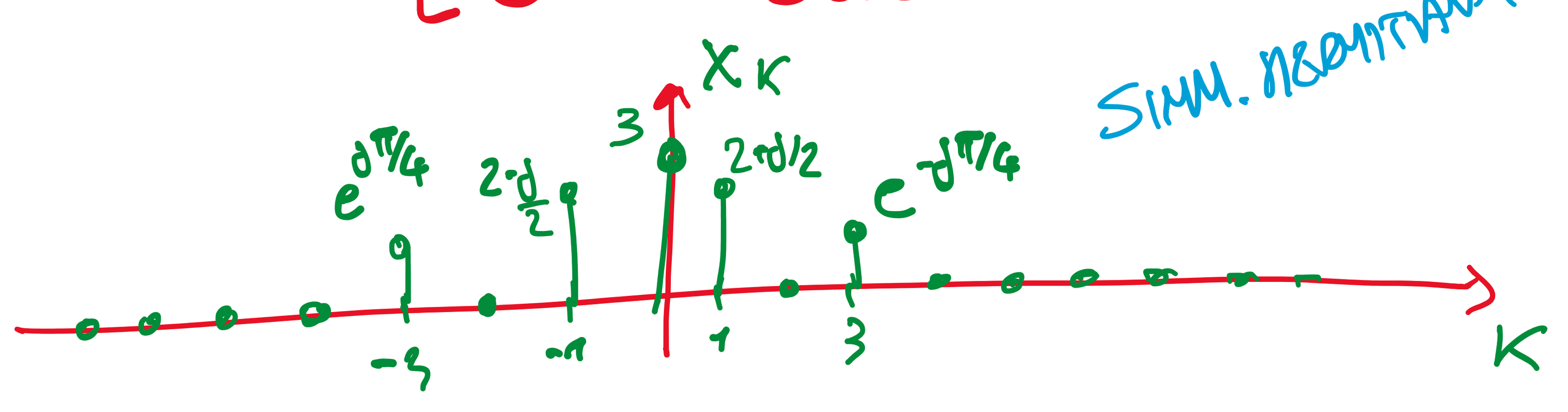
$$= 3 e^{j0\omega_0 t} + \frac{j}{2} e^{j\omega_0 t} - \frac{j}{2} e^{-j\omega_0 t} + 2e^{j\omega_0 t} + 2e^{-j\omega_0 t} + e^{-j\pi/4} e^{j3\omega_0 t} + e^{j\pi/4} e^{-j3\omega_0 t}$$

(X_0, $k=0$; $k=1$; $k=-1$; X_3, $k=3$; X_{-3}, $k=-3$)

$X_1 = 2 + \frac{j}{2}$ $X_{-1} = 2 - \frac{j}{2}$

$$X_k = \begin{cases} 3 & k=0 \\ 2+j/2 & k=1 \\ 2-j/2 & k=-1 \\ e^{-j\pi/4} & k=3 \\ e^{j\pi/4} & k=-3 \\ 0 & \text{altrove} \end{cases}$$

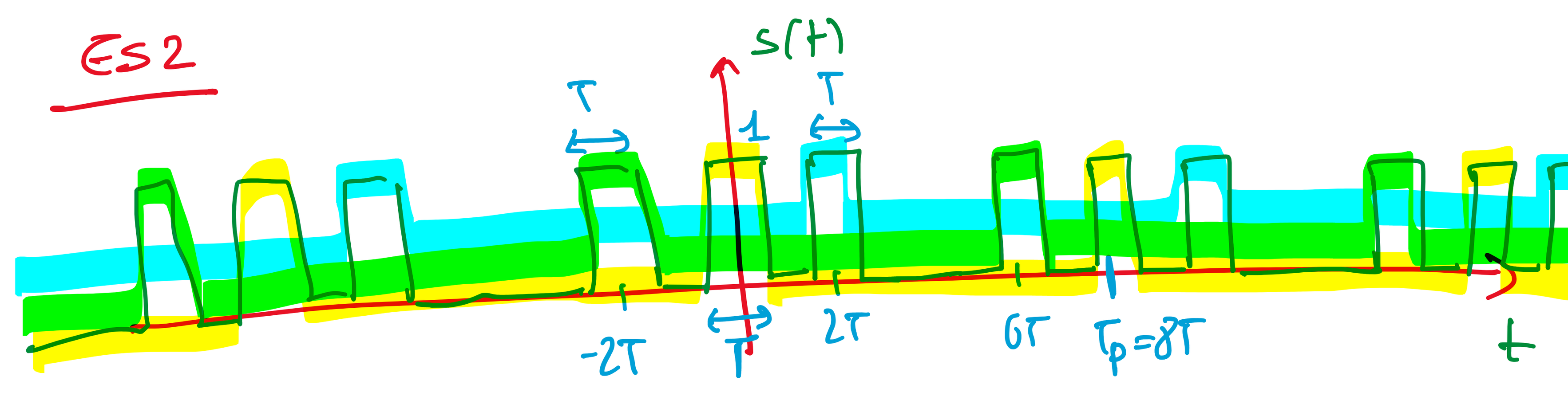
($k=1$, $k=-1$: complessi coniugati; $k=3$, $k=-3$: compl. coniugati)



x CASA $m_x = ?$

$P_x = ?$

Es 2



$$s(t) = \mathrm{rep}_{8T}\, \mathrm{rect}\left(\frac{t}{T}\right) + \mathrm{rect}\left(\frac{t-2T}{T}\right) + \mathrm{rect}\left(\frac{t+2T}{T}\right)$$

$S_k = ?$

$$s(t) = \mathrm{rep}_{8T}\, \mathrm{rect}\left(\frac{t}{T}\right) + \mathrm{rep}_{8T}\, \mathrm{rect}\left(\frac{t-2T}{T}\right) + \mathrm{rep}_{8T}\, \mathrm{rect}\left(\frac{t+2T}{T}\right)$$

$u(t) = \mathrm{rep}_{8T}\, \mathrm{rect}\left(\frac{t}{T}\right)$ onda quadra $d = \frac{T}{8T} = \frac{1}{8}$

$s(t) = u(t) + u(t-2T) + u(t+2T)$

$T_p = 8T$ $\omega_0 = \frac{2\pi}{T_p} = \frac{\pi}{4T}$

$$U_k = d\,\mathrm{sinc}(kd) = \frac{1}{8}\mathrm{sinc}(k/8)$$

$s(t) = u(t) + u(t-2T) + u(t+2T)$

$$S_k = U_k + U_k e^{-jk\omega_0 2T} + U_k e^{jk\omega_0 2T}$$

$$= U_k\left(1 + 2\cos\left(k\frac{\pi}{4T} 2T\right)\right)$$

$$= U_k\left(1 + 2\cos(k\pi/2)\right)$$

$$= \frac{1}{8}\mathrm{sinc}\left(\frac{k}{8}\right)\left(1 + 2\cos(k\pi/2)\right)$$

Es 1c REVISITED

$$s(t) = \cos(\omega_0 t + \varphi_0) = \frac{e^{j\varphi_0}}{2} e^{j\omega_0 t} + \frac{e^{-j\varphi_0}}{2} e^{-j\omega_0 t}$$

(segnale costante × modulazione; segnale cost. × modul.; $m\,\omega_0$, $m=1$, $e^{jm\omega_0 t}$; $m\,\omega_0$, $m=-1$)

$S_k = ?$

$\frac{e^{j\varphi_0}}{2}\delta(k)$ $\frac{e^{-j\varphi_0}}{2}\delta(k)$

regola di modulazione

$$S_k = \frac{e^{j\varphi_0}}{2}\delta(k-1) + \frac{e^{-j\varphi_0}}{2}\delta(k+1)$$

$s(t) = x(t)e^{j\omega_0 t} + y(t)e^{-j\omega_0 t}$

$x(t) = \frac{e^{j\varphi_0}}{2} \xrightarrow{\mathcal{F}} X_k = \frac{e^{j\varphi_0}}{2}\delta(k)$

$y(t) = \frac{e^{-j\varphi_0}}{2} \xrightarrow{\mathcal{F}} Y_k = \frac{e^{-j\varphi_0}}{2}\delta(k)$

$\mathcal{F}$: $S_k = X_{k-1} + Y_{k+1}$