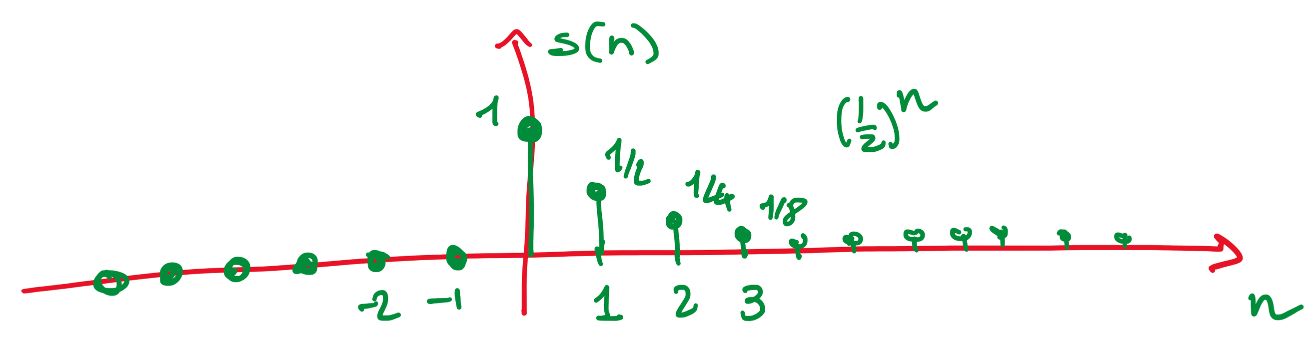
Le03

Friday, 27 February 2026 08:31

Es1

$A_s, m_s, \mathcal{E}_s, P_s$ PER $s(n) = \left(\frac{1}{2}\right)^n 1_0(n)$



$$A_s = \sum_{n=\cancel{-\infty}\ 0}^{+\infty} \left(\frac{1}{2}\right)^n \cancel{1_0(n)} = \sum_{n=0}^{+\infty} \left(\frac{1}{2}\right)^n = \frac{1}{1-\frac{1}{2}} = 2$$

SERIE GEOMETRICA

$$\sum_{n=0}^{N-1} \alpha^n = \frac{1-\alpha^N}{1-\alpha}$$

$$\sum_{n=0}^{+\infty} \alpha^n = \lim_{N\to\infty} \frac{1-\alpha^N}{1-\alpha} = \frac{1}{1-\alpha}$$

$|\alpha|<1$

$$m_s = 0$$

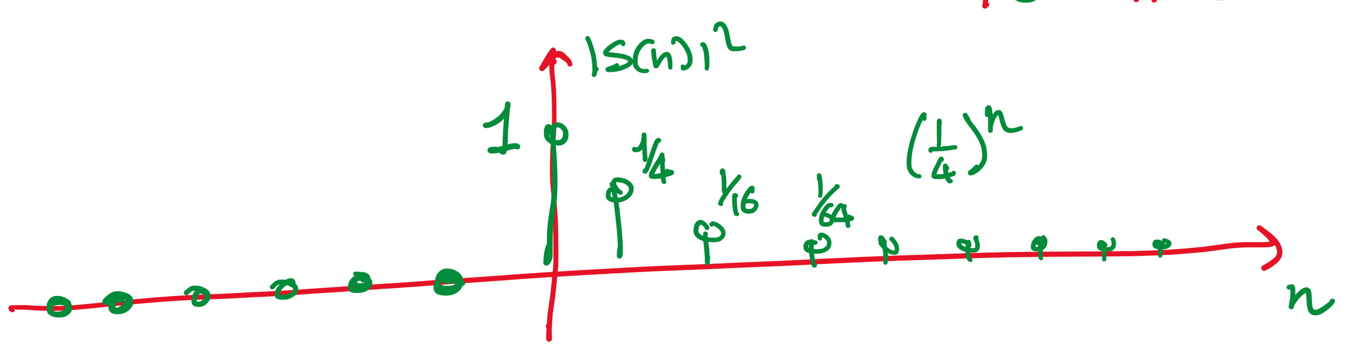
$$|s(n)|^2 = \left|\left(\frac{1}{2}\right)^n 1_0(n)\right|^2$$

$$= \left|\left(\frac{1}{2}\right)^n\right|^2 \cdot |1_0(n)|^2$$

$$= \left(\frac{1}{2}\right)^{2n} \cdot \left(1_0(n)\right)^2 = \left(\frac{1}{4}\right)^n \cdot 1_0(n)$$

$$1_0(n) = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases}$$

$$(1_0(n))^2 = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases} = 1_0(n)$$



$$\mathcal{E}_s = \sum_{n=\cancel{-\infty}\ 0}^{+\infty} \left(\frac{1}{4}\right)^n \cancel{1_0(n)} = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}$$

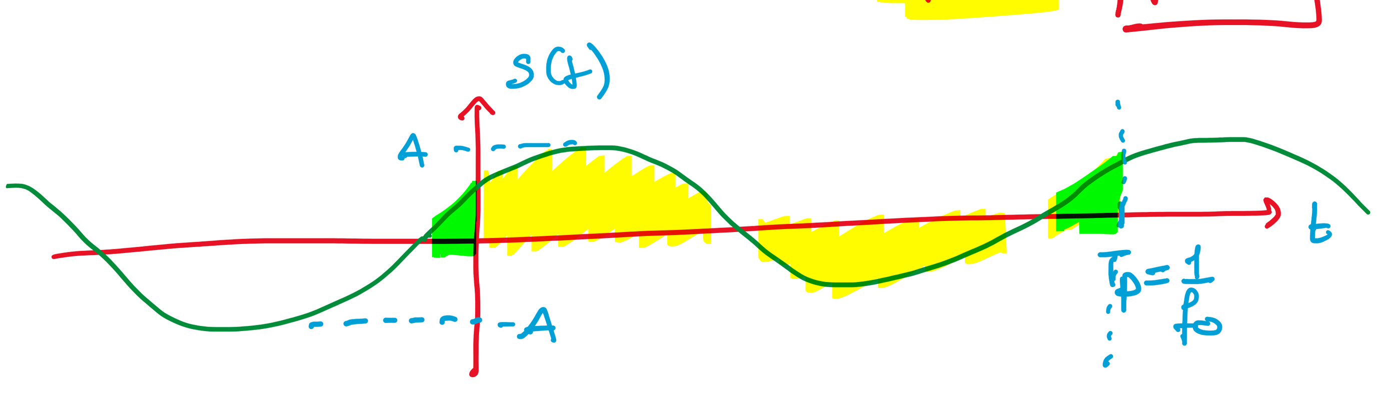
$$P_s = 0$$

Es2

m_s, P_s PER $s(t) = A\cos(2\pi f_0 t + \varphi_0)$

$A > 0$

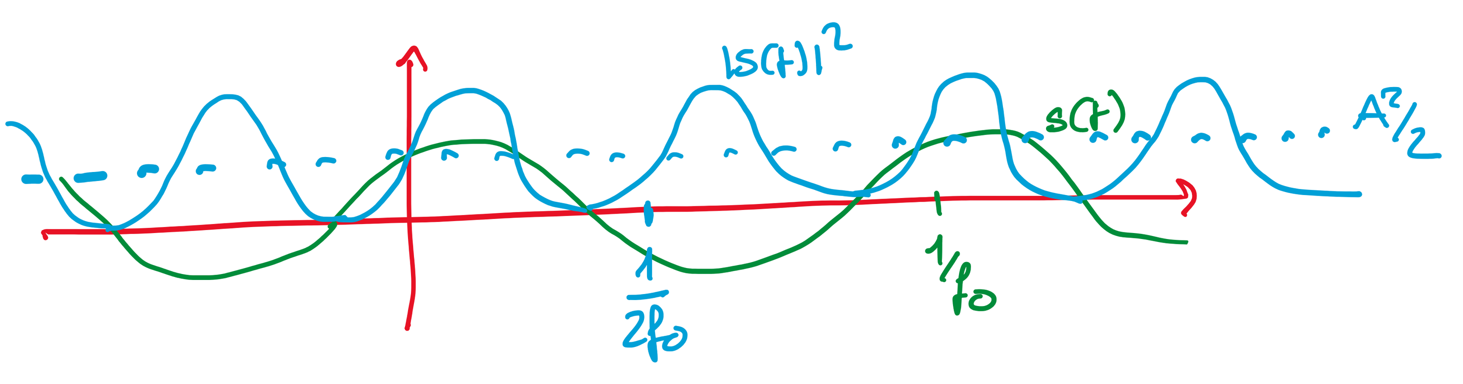
$f_0 > 0$ $\boxed{f_0 \neq 0}$



$$m_s = \frac{A_s(T_p)}{T_p} = 0 \qquad A_s(T_p) = \int_0^{1/f_0} A\cos(2\pi f_0 t + \varphi_0)\,dt = 0$$

$$|s(t)|^2 = A^2 \cos^2(2\pi f_0 t + \varphi_0) \longleftarrow \cos^2\alpha = \frac{1+\cos(2\alpha)}{2}$$

$$= \frac{A^2}{2} + \frac{A^2}{2}\cos(2\pi \cdot 2f_0 t + 2\varphi_0)$$



$$P_s = \frac{\int_0^{T_p} \frac{A^2}{2}\,dt}{T_p} + 0$$

$$= \frac{\cancel{T_p}\ A^2/2}{\cancel{T_p}} + 0 = \frac{A^2}{2}$$

Es3

m_s, P_s DI $s(t) = A e^{j2\pi f_0 t}$ $f_0 > 0$ A reale

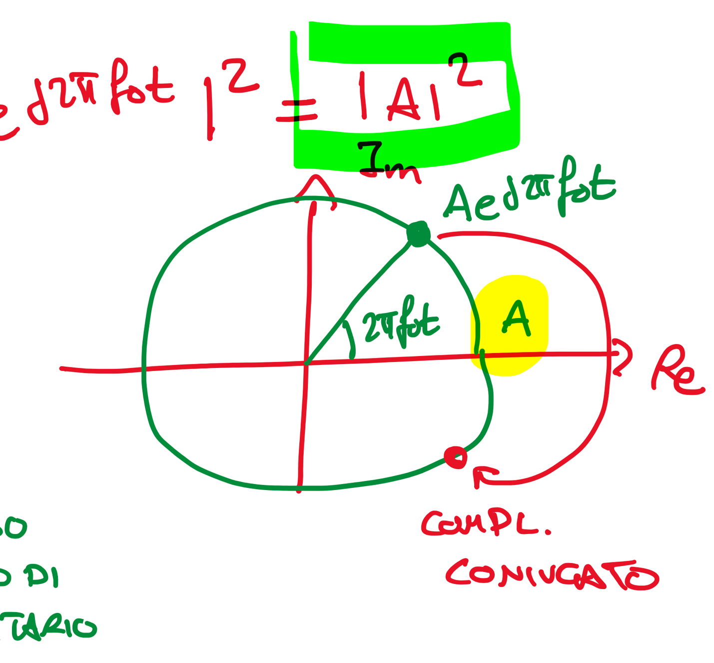
$$s(t) = A\cos(2\pi f_0 t) + jA\sin(2\pi f_0 t)$$

$$m_s = 0 + j0 = 0$$

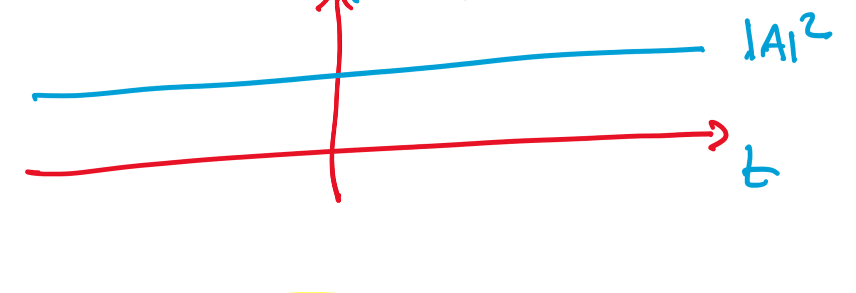
$$|s(t)|^2 = |A \cdot e^{j2\pi f_0 t}|^2 = |A|^2$$

$$= |A|^2 \cdot \underbrace{|e^{j2\pi f_0 t}|^2}$$

NUM COMPLESSO SUL CERCHIO DI RAGGIO UNITARIO
↓
MODULO = 1



$$P_s = |A|^2$$



Es4

m_s, P_s DI $s(t) = A_1 e^{j2\pi f_1 t} + A_2 e^{j2\pi f_2 t}$

$f_1 \neq f_2$

$f_1, f_2 \neq 0$

$$m_s = 0$$

$$|s(t)|^2 = s(t) \cdot s^*(t)$$

$$= \left(A_1 e^{j2\pi f_1 t} + A_2 e^{j2\pi f_2 t}\right) \cdot \left(A_1^* e^{-j2\pi f_1 t} + A_2^* e^{-j2\pi f_2 t}\right)$$

$$= A_1 A_1^* \cancel{e^{j2\pi f_1 t}}\ \cancel{e^{-j2\pi f_1 t}}$$

$$+ A_1 A_2^* e^{j2\pi f_1 t} e^{-j2\pi f_2 t}$$

$$+ A_2 A_1^* e^{j2\pi f_2 t} e^{-j2\pi f_1 t}$$

$$+ A_2 A_2^* \cancel{e^{j2\pi f_2 t}}\ \cancel{e^{-j2\pi f_2 t}}$$

$$|s(t)|^2 = |A_1|^2 + A_1 A_2^* e^{j2\pi(f_1-f_2)t} + A_2 A_1^* e^{j2\pi(f_2-f_1)t} + |A_2|^2$$

$$P_s = |A_1|^2 + 0 + 0 + |A_2|^2$$

$$= |A_1|^2 + |A_2|^2$$

PER LE SOMME DI ESPONENZIALI COMPLESSI A FASE LINEARE $e^{j2\pi f_0 t}$

I VALORI MEDI E LE POTENZE SI SOMMANO

NOTA

$$s(t) = A\cos(2\pi f_0 t + \varphi_0) \longleftarrow \text{EULERO } \cos(\alpha) = \frac{e^{j\alpha} + e^{-j\alpha}}{2}$$

$$= \frac{A}{2} e^{j\varphi_0} e^{j2\pi f_0 t} + \frac{A}{2} e^{-j\varphi_0} e^{-j2\pi f_0 t}$$

$$P_s = \left|\frac{A}{2} \cancel{e^{j\varphi_0}}\right|^2 + \left|\frac{A}{2} \cancel{e^{-j\varphi_0}}\right|^2$$

$$= \frac{A^2}{4} + \frac{A^2}{4} = \frac{A^2}{2}$$