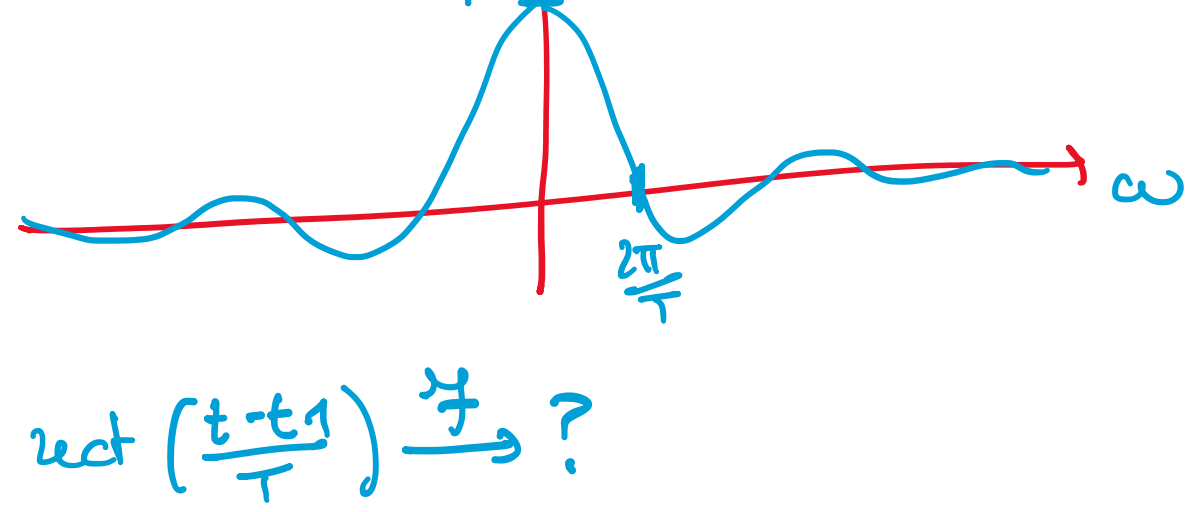


Es1b $s(t) = \text{rect}(t/T)$
 $S(j\omega) = ?$

$x(t) = \text{rect}(t/T) \xrightarrow{\mathcal{F}} X(j\omega) = \text{sinc}\left(\frac{\omega T}{2\pi}\right)$
 $s(t) = x(t/T) \xrightarrow{\text{scaling}} S(j\omega) = T X(jT\omega)$
 $= T \text{sinc}\left(\frac{T\omega}{2\pi}\right)$
 $= T \text{sinc}\left(\frac{\omega}{2\pi/T}\right)$



Xcasa $\text{rect}\left(\frac{t-t_1}{T}\right) \xrightarrow{\mathcal{F}} ?$

Es1a $s(t) = \text{sinc}(t)$
 $S(j\omega) = ?$

$\text{rect}(t) \xrightarrow{\mathcal{F}} \text{sinc}\left(\frac{\omega}{2\pi}\right)$
 $\text{sinc}\left(\frac{t}{2\pi}\right) \xrightarrow{\mathcal{F}} 2\pi \text{rect}(-\omega) = 2\pi \text{rect}(\omega)$

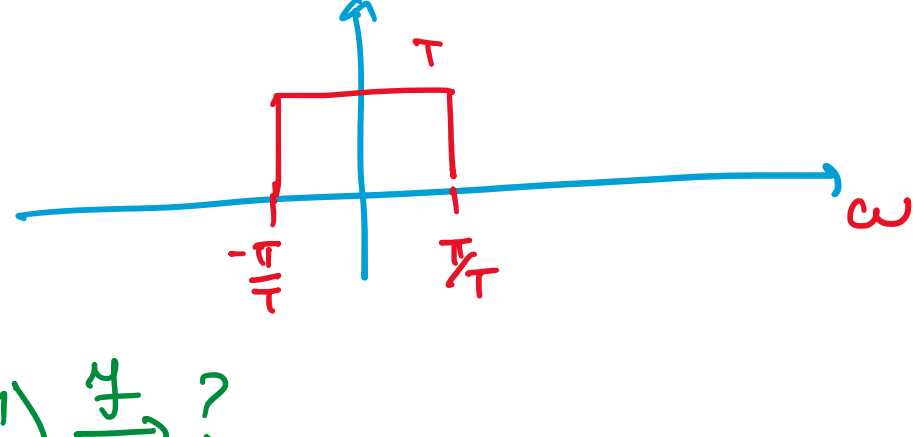
PROVALE X ANTITRASFORMATA
 $2\pi \text{rect}(\omega) \xrightarrow{\mathcal{F}^{-1}} \text{sinc}\left(\frac{t}{2\pi}\right)$

$x(t) = \text{sinc}\left(\frac{t}{2\pi}\right) \xrightarrow{\mathcal{F}} X(j\omega) = 2\pi \text{rect}(\omega)$
 $s(t) = \text{sinc}(t) = x\left(\frac{t}{2\pi}\right) \xrightarrow{\text{scaling}} S(j\omega) = \frac{1}{2\pi} X(j\omega)$
 $= \frac{1}{2\pi} \cdot 2\pi \text{rect}\left(\frac{\omega}{2\pi}\right) = \text{rect}\left(\frac{\omega}{2\pi}\right)$

$\text{sinc}(t) \xrightarrow{\mathcal{F}} \text{rect}\left(\frac{\omega}{2\pi}\right)$
 $\text{rect}(t) \xrightarrow{\mathcal{F}} \text{sinc}\left(\frac{\omega}{2\pi}\right)$

sinc e rect sono segnali **DUALI**

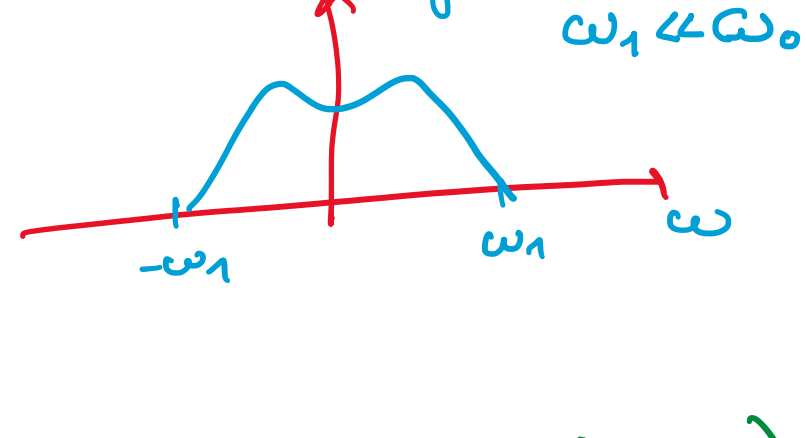
Es1b $\text{sinc}(t/T) \xrightarrow{\mathcal{F}} ?$ $T \text{rect}\left(\frac{\omega T}{2\pi}\right)$



Xcasa $\text{sinc}\left(\frac{t-t_1}{T}\right) \xrightarrow{\mathcal{F}} ?$

NOTA SU ALTRA ES. PROPOSTI SI USA UN'INTERCAMBIO IN F: S(f)
 $\omega = 2\pi f \rightarrow S(j\omega) = S(f) \Big|_{f=\frac{\omega}{2\pi}}$
 $f = \frac{\omega}{2\pi}$

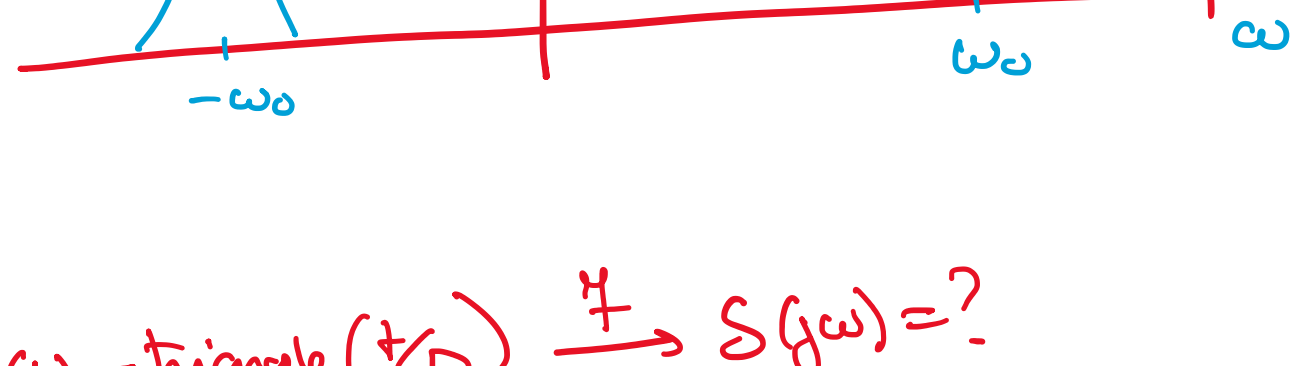
Es1j $s(t) = x(t) \cos(\omega_0 t)$



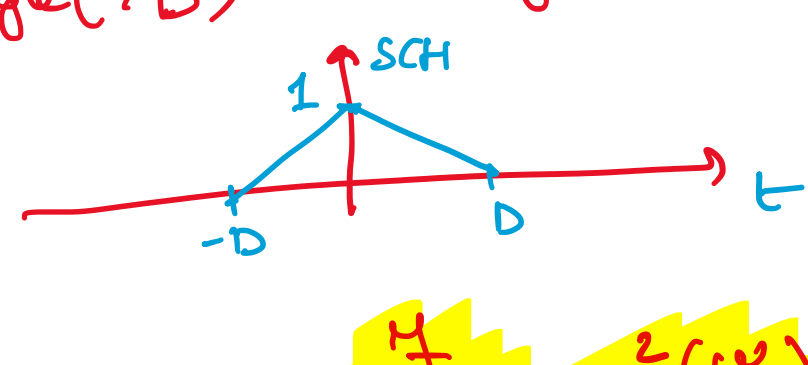
$x(t) \xrightarrow{\mathcal{F}} X(j\omega)$
 $y(t) = \cos(\omega_0 t) \xrightarrow{\mathcal{F}} Y(j\omega) = \pi \delta(\omega - \omega_0) + \pi \delta(\omega + \omega_0)$

$s(t) = x(t)y(t) \xrightarrow{\mathcal{F}} S(j\omega) = \frac{1}{2\pi} X * Y(j\omega)$

$S(j\omega) = \frac{1}{2\pi} X(j\omega) * [\pi \delta(\omega - \omega_0) + \pi \delta(\omega + \omega_0)]$
 $= \frac{1}{2\pi} [\pi X(j(\omega - \omega_0)) + \pi X(j(\omega + \omega_0))]$
 $= \frac{1}{2} X(j(\omega - \omega_0)) + \frac{1}{2} X(j(\omega + \omega_0))$

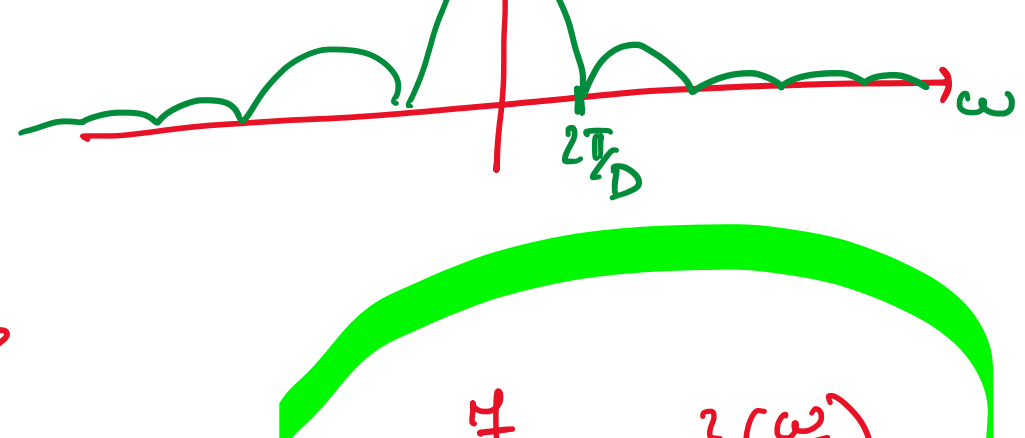


Es1i $s(t) = \text{triangle}(t/D) \xrightarrow{\mathcal{F}} S(j\omega) = ?$



$x(t) = \text{triangle}(t) = \text{rect} * \text{rect}(t) \xrightarrow{\mathcal{F}} \text{sinc}^2\left(\frac{\omega}{2\pi}\right)$
 $\text{rect}(t) \xrightarrow{\mathcal{F}} \text{sinc}\left(\frac{\omega}{2\pi}\right)$

$s(t) = x(t/D) \xrightarrow{\text{scaling}} S(j\omega) = D X(j\omega D) = D \text{sinc}^2\left(\frac{\omega D}{2\pi}\right)$



Es $\text{sinc}^2(t) \xrightarrow{\mathcal{F}} ?$

$\text{triangle}(t) \xrightarrow{\mathcal{F}} \text{sinc}\left(\frac{\omega}{2\pi}\right)$
 $\text{sinc}^2\left(\frac{t}{2\pi}\right) \xrightarrow{\mathcal{F}} 2\pi \text{triangle}(t\omega)$

$x(t) = \text{sinc}^2\left(\frac{t}{2\pi}\right) \xrightarrow{\mathcal{F}} 2\pi \text{triangle}(\omega)$

$s(t) = \text{sinc}^2(t) = x\left(\frac{t}{2\pi}\right) \xrightarrow{\text{scaling}} S(j\omega) = \frac{1}{2\pi} X(j\frac{\omega}{2\pi})$
 $= \frac{1}{2\pi} \cdot 2\pi \text{triangle}\left(\frac{\omega}{2\pi}\right)$

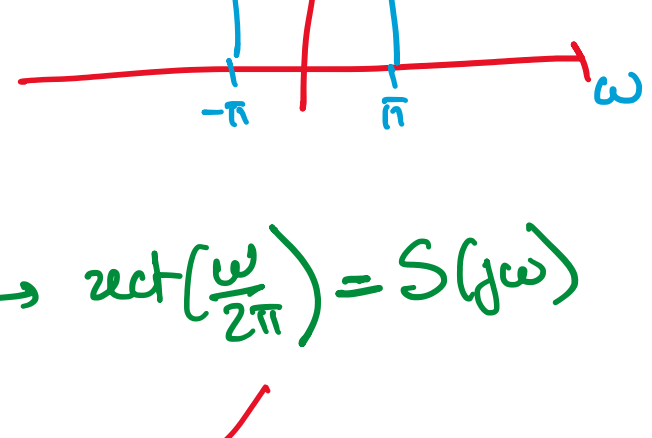
$\text{triangle}(t) \xrightarrow{\mathcal{F}} \text{sinc}^2\left(\frac{\omega}{2\pi}\right)$
 $\text{sinc}^2(t) \xrightarrow{\mathcal{F}} \text{triangle}\left(\frac{\omega}{2\pi}\right)$

DUALITA' TRIANGLE - SINCCUADRO

Xcasa $\text{sinc}^2\left(\frac{t-t_1}{T}\right) \xrightarrow{\mathcal{F}} ?$
 $\text{triangle}\left(\frac{t-t_1}{T}\right) \xrightarrow{\mathcal{F}} ?$

Es1e $s(t) = \text{sinc} * \text{sinc}(t)$
 $S(j\omega) = ?$
 $s(t) = ?$

$s(t) = \text{sinc} * \text{sinc}(t)$
 $\mathcal{F} \downarrow \quad \downarrow \mathcal{F} \quad \downarrow \mathcal{F}$
 $S(j\omega) = \text{rect}\left(\frac{\omega}{2\pi}\right) \cdot \text{rect}\left(\frac{\omega}{2\pi}\right) = \text{rect}^2\left(\frac{\omega}{2\pi}\right)$
 $= \text{rect}\left(\frac{\omega}{2\pi}\right) = S(j\omega)$

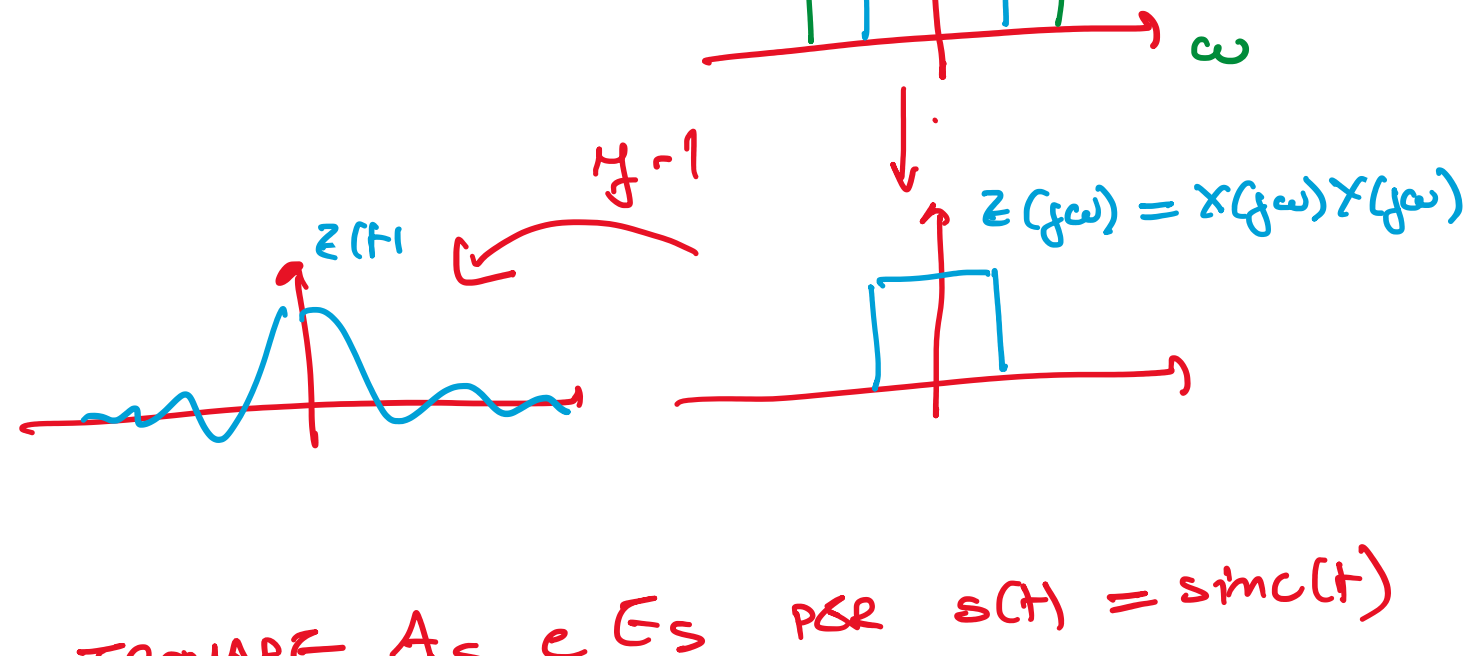


$s(t) = \text{sinc}(t) \xrightarrow{\mathcal{F}} \text{rect}\left(\frac{\omega}{2\pi}\right) = S(j\omega)$

$\text{sinc} * \text{sinc}(t) = \text{sinc}(t)$

Xcasa $z(t) = x + y(t)$ con $x(t) = \text{sinc}(t/2)$
 $y(t) = \text{sinc}(t/3)$

TROVARE $Z(j\omega) = ?$
 $z(t) = ?$ \times ANTITRASFORMATA DI $Z(j\omega)$



Es TROVARE A_s e E_s PER $s(t) = \text{sinc}(t)$

$\text{sinc}(t) \xrightarrow{\mathcal{F}} \text{rect}\left(\frac{\omega}{2\pi}\right) = S(j\omega)$

$A_s = \int_{-\infty}^{+\infty} \text{sinc}(t) dt = S(j\omega) \Big|_{\omega=0} = \text{rect}\left(\frac{0}{2\pi}\right) = 1$

$E_s = \int_{-\infty}^{+\infty} \text{sinc}^2(t) dt = \frac{1}{2\pi} \int_{-\infty}^{+\infty} |S(j\omega)|^2 d\omega$
 $= \frac{1}{2\pi} \int_{-\pi}^{+\pi} \text{rect}^2\left(\frac{\omega}{2\pi}\right) d\omega = \frac{2\pi}{2\pi} = 1$