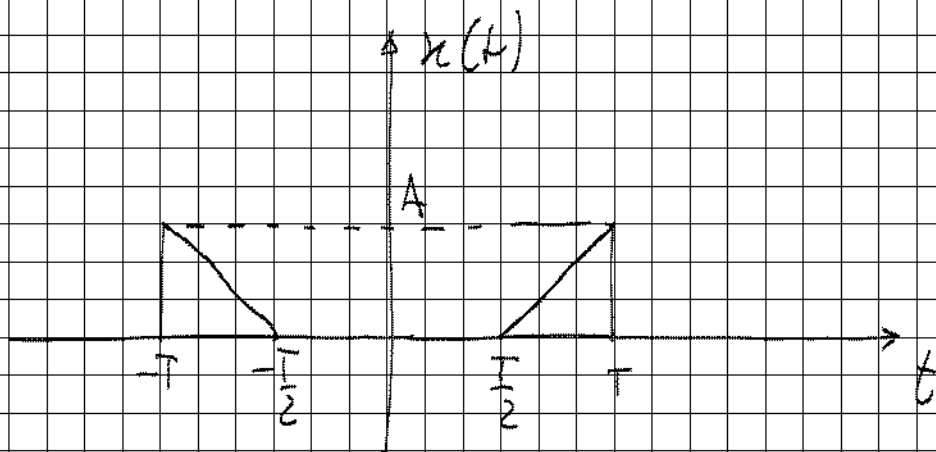
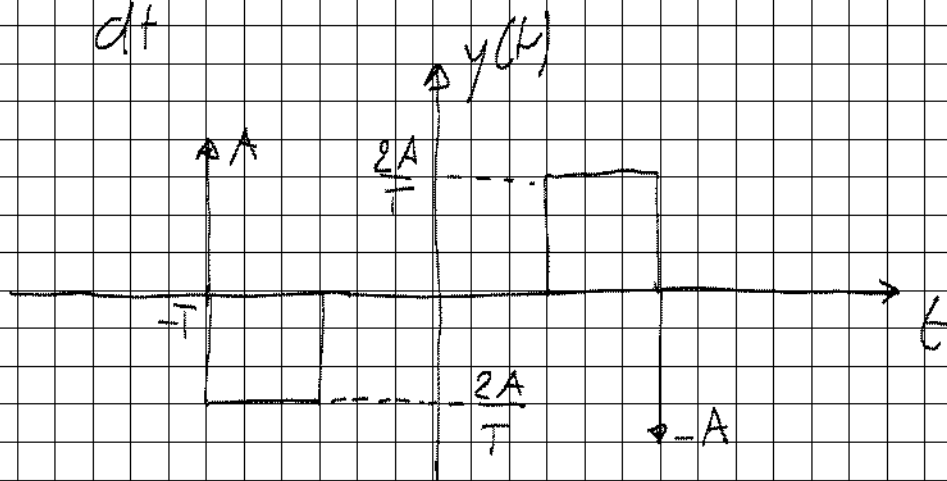


ESERCIZIO - FUNZIONI LINEARI A TRATTI



Calcolare $X(f)$

$$y(t) = \frac{d}{dt} x(t)$$



$$y(t) = A \delta(t+T) - A \delta(t-T) - \frac{2A}{T} \text{rect}\left(\frac{t+\frac{3}{2}T}{T/2}\right) + \frac{2A}{T} \text{rect}\left(\frac{t-\frac{3}{2}T}{T/2}\right)$$

$$= -A \left[\delta(t-T) - \delta(t+T) \right] + \frac{2A}{T} \left[\text{rect}\left(\frac{t-\frac{3}{2}T}{T/2}\right) - \text{rect}\left(\frac{t+\frac{3}{2}T}{T/2}\right) \right]$$

$$Y(f) = -A \left[e^{-j2\pi fT} - e^{j2\pi fT} \right] + \frac{2A}{T} \left[\frac{T}{2} \text{sinc}\left(\frac{T}{2}f\right) e^{-j2\pi f\frac{3}{4}T} - \frac{T}{2} \text{sinc}\left(\frac{T}{2}f\right) e^{j2\pi f\frac{3}{4}T} \right] =$$

$$= 2jA \sin(2\pi fT) - A \operatorname{sinc}\left(\frac{T}{2}f\right) \left(e^{j\frac{3}{2}\pi fT} - e^{-j\frac{3}{2}\pi fT} \right) =$$

$$= 2jA \sin(2\pi fT) - 2jA \operatorname{sinc}\left(\frac{T}{2}f\right) \sin\left(\frac{3}{2}\pi fT\right)$$

$$X(f) = \frac{Y(f)}{j2\pi f} + \frac{Y(0)}{2} \delta(f)$$

$$Y(0) = 0$$

$$X(f) = \frac{A}{\pi f} \sin(2\pi fT) - \frac{A}{\pi f} \operatorname{sinc}\left(\frac{T}{2}f\right) \sin\left(\frac{3}{2}\pi fT\right) =$$

$$= 2AT \operatorname{sinc}(2fT) - \frac{3}{2}AT \operatorname{sinc}\left(\frac{T}{2}f\right) \operatorname{sinc}\left(\frac{3}{2}fT\right)$$

ESERCIZIO - MODULAZIONE DI AMPIEZZA (AM)

$$y(t) = x(t) \cos(2\pi f_0 t)$$

$$x(t) = AB \operatorname{sinc}^2(Bt)$$

Calcolare $Y(f)$

Soluzione:

$$Y(f) = X(f) \otimes \operatorname{FT}[\cos(2\pi f_0 t)]$$

$$Y(f) = \left[A \left(1 - \frac{|f|}{B} \right) \operatorname{rect}\left(\frac{f}{2B}\right) \right] \otimes \left[\frac{1}{2} \delta(f-f_0) + \frac{1}{2} \delta(f+f_0) \right]$$

$$= \frac{A}{2} \left(1 - \frac{|f-f_0|}{B} \right) \text{rect} \left(\frac{f-f_0}{2B} \right) + \frac{A}{2} \left(1 - \frac{|f+f_0|}{B} \right) \text{rect} \left(\frac{f+f_0}{2B} \right)$$

ESERCIZIO - AM con fase

$$y(t) = x(t) \cos(2\pi f_0 t + \varphi)$$

$$x(t) = AB \sin^2(Bt)$$

Calcolare $Y(f)$

$$Y(f) = A \left(1 - \frac{|f|}{B} \right) \text{rect} \left(\frac{f}{2B} \right) \otimes \left[\frac{e^{j\varphi}}{2} \delta(f-f_0) + \frac{e^{-j\varphi}}{2} \delta(f+f_0) \right]$$

$$= Ae^{j\varphi} \left(1 - \frac{|f-f_0|}{B} \right) \text{rect} \left(\frac{f-f_0}{2B} \right) + Ae^{-j\varphi} \left(1 - \frac{|f+f_0|}{B} \right) \text{rect} \left(\frac{f+f_0}{2B} \right)$$

ESERCIZIO - TCF DI SINUSOIDI MULTICOMPONENTE

$$x(t) = A \cos(2\pi f_1 t) + B \cos(2\pi f_2 t)$$

$$f_1/f_2 = K \in \mathbb{R} \quad (\text{non intero})$$

Soluzione

$$X(f) = \frac{A}{2} \left[\delta(f-f_1) + \delta(f+f_1) \right] + \frac{B}{2} \left[\delta(f-f_2) + \delta(f+f_2) \right]$$

$\uparrow X(f)$

