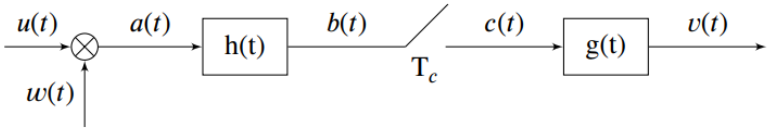
2. Dato il seguente schema a blocchi,



$u(t) = \text{sinc}(2t) + 2 \quad h(t) = 4\,\text{sinc}(10t)$

$w(t) = 4\cos(10\pi t) \quad g(t) = 2\,\text{sinc}(2t) \quad T_c = 100\ ms$

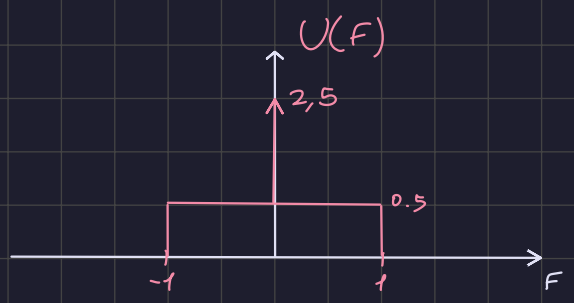
$u(t) = \text{sinc}(2t) + 2 = \frac{1}{2} \cdot 2\,\text{sinc}(2t) + 2 \xrightarrow{F} U(f) = \frac{1}{2}\Pi\left(\frac{f}{2}\right) + 2\delta(f)$

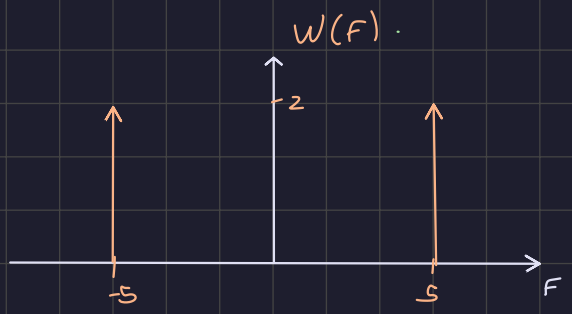
$w(t) = 4\cos(10\pi t) = 4 \cdot \cos(2\pi \cdot 5t) \xrightarrow{F} W(f) = 2\delta(f-5) + 2\delta(f+5)$

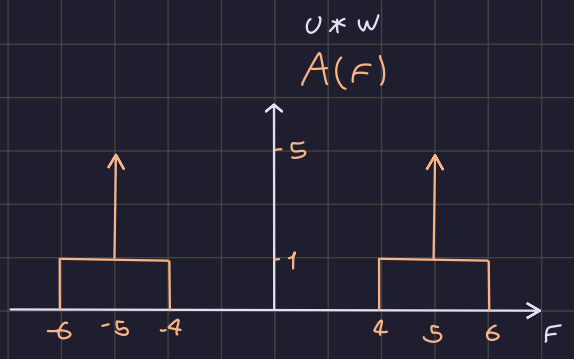
$h(t) = 4\,\text{sinc}(10t) = \frac{2}{5} 10\,\text{sinc}(10t) \xrightarrow{F} H(f) = \frac{2}{5}\Pi\left(\frac{f}{10}\right)$

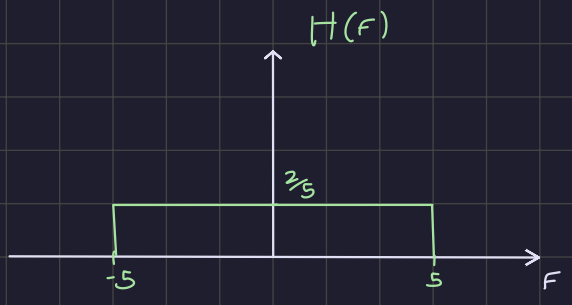
$g(t) = 2\,\text{sinc}(2t) \rightarrow G(f) = \Pi\left(\frac{f}{2}\right)$

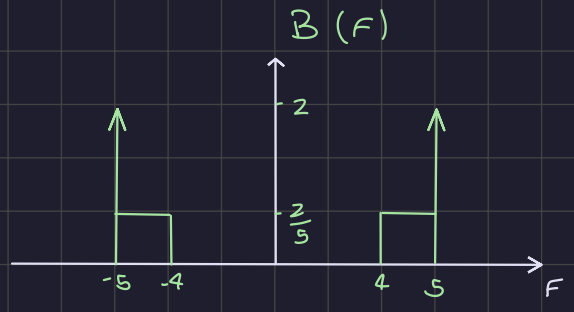
$T_c = 0{,}1\ s \qquad f_c = \frac{1}{T_c} = 10\ Hz$

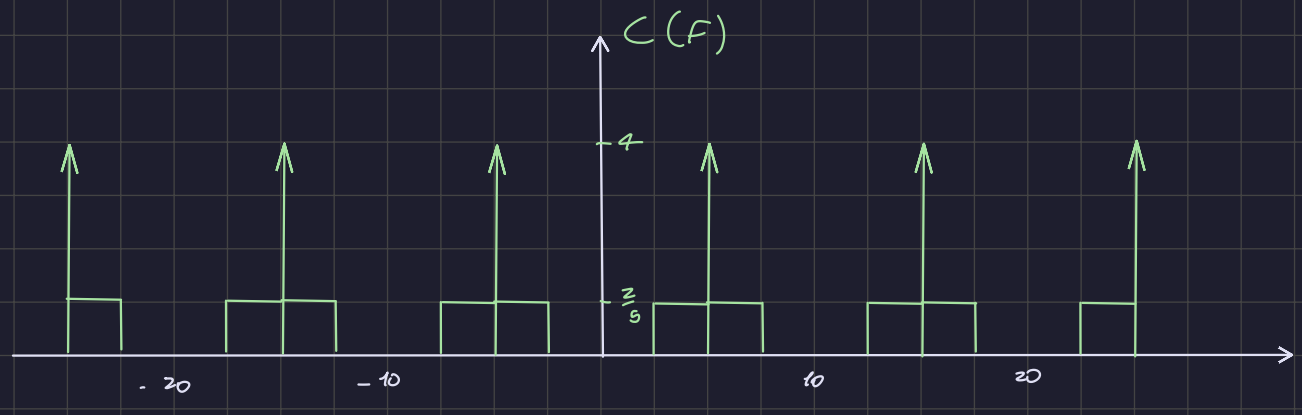


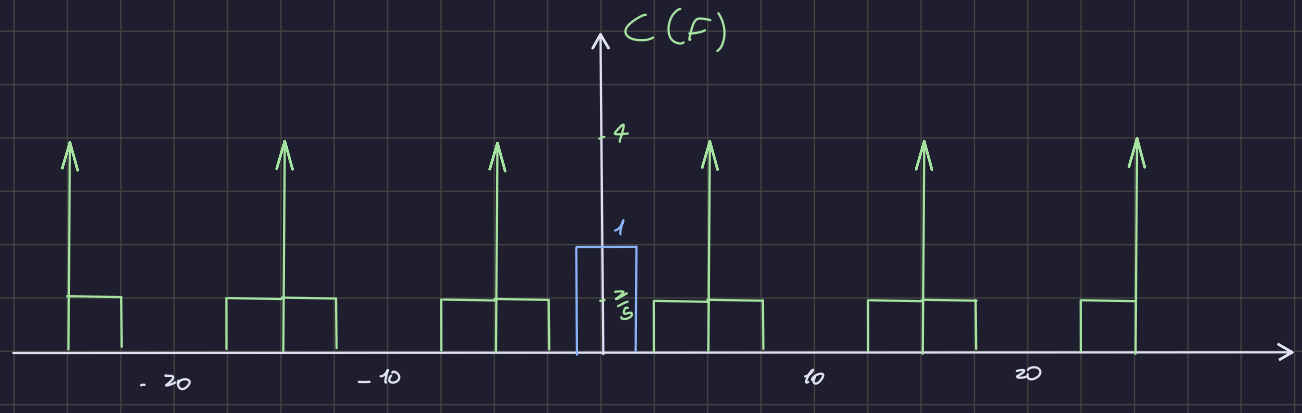


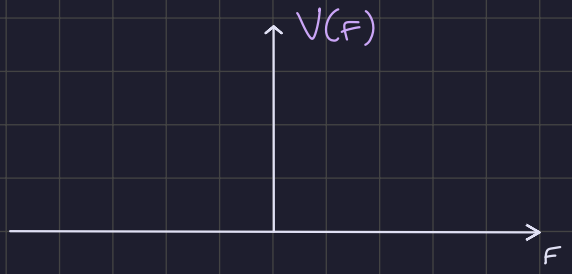








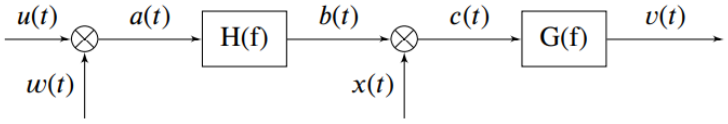




$V(f) = 0 = v(t)$

Si verifica perchè f_c ≤ 2B dove B = 5, di conseguenza il segnale viene sovrapposto agli altri creando il fenomeno di aliasing e quindi non si può più ricostruire.

3. Dato il seguente schema a blocchi,



$$u(t) = \mathrm{sinc}^2(t)$$
$$w(t) = \cos(10\pi t)$$
$$x(t) = \cos(6\pi t)$$

$$H(f) = \begin{cases} 2 & \text{se } 3 \le |f| \le 5 \\ 0 & \text{altrimenti} \end{cases} \qquad G(f) = \begin{cases} 2 & \text{se } |f| \le 3 \\ 0 & \text{altrimenti} \end{cases}$$

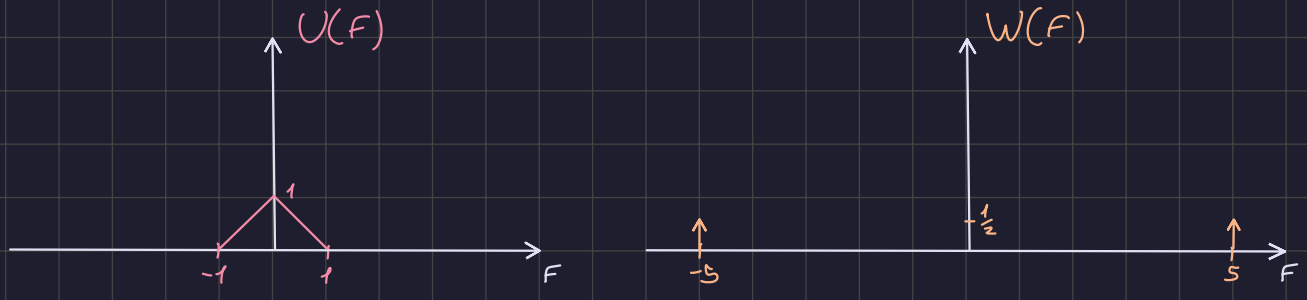
$u(t) = 1 \cdot 1 \, \mathrm{sinc}^2(1t) \xrightarrow{F} U(f) = \Lambda(f)$

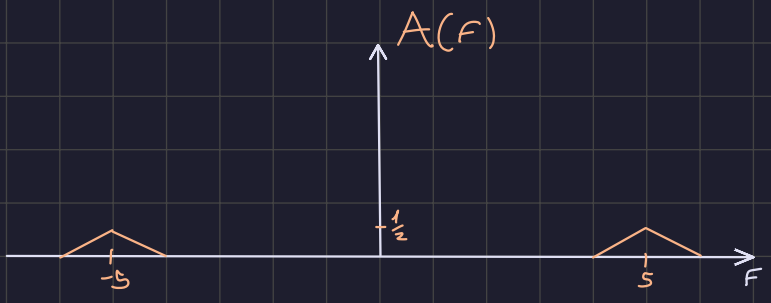
$w(t) = \cos(2\pi 5t) \xrightarrow{F} W(f) = \frac{1}{2}\delta(f-5) + \frac{1}{2}\delta(f+5)$

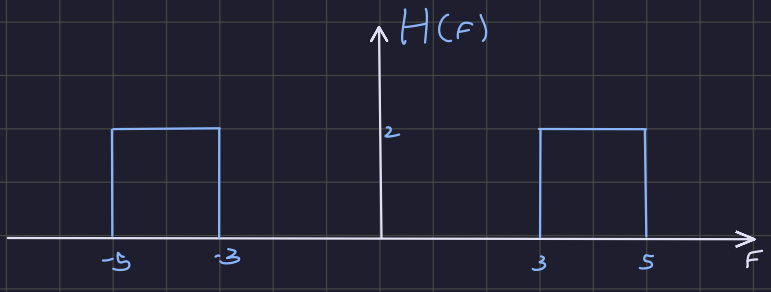
$x(t) = \cos(2\pi 3t) \xrightarrow{F} X(f) = \frac{1}{2}\delta(f-3) + \frac{1}{2}\delta(f+3)$

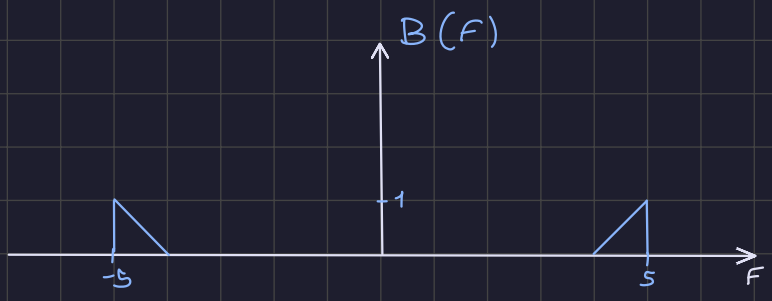
$$H(f) = \begin{cases} 2 & \text{se } 3 \le |f| \le 5 \\ 0 \end{cases}$$

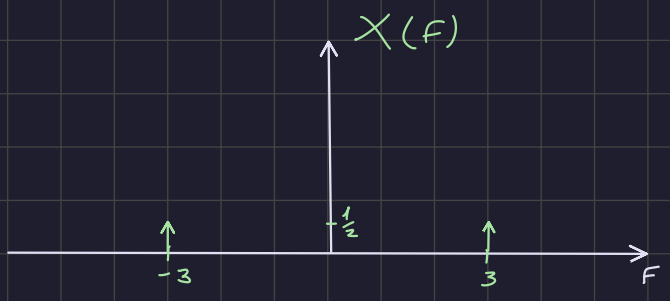
$$G(f) = \begin{cases} 2 & \text{se } |f| \le 3 \\ 0 \end{cases}$$

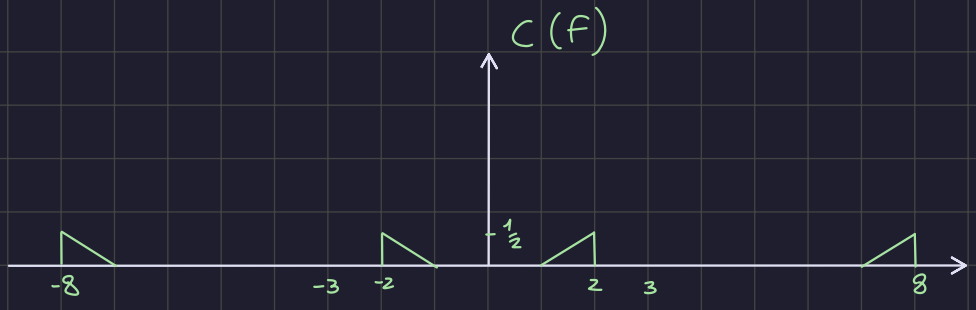


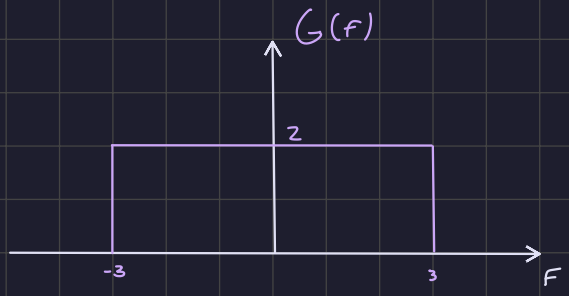


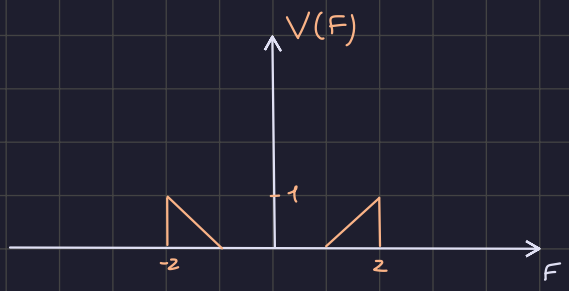










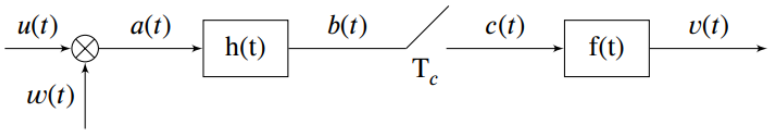


$$V(f) = \left(\Lambda(f+2) + \Lambda(f-2)\right) \cdot \Pi\left(\frac{f}{4}\right)$$

$$\downarrow \mathcal{F}^{-1}$$

$$v(t) = \left(\text{sinc}^2(t+2) + \text{sinc}^2(t-2)\right) * 4\,\text{sinc}(4t)$$

1. Dato il seguente schema a blocchi,



$u(t) = 3\cos(6\pi t) + \cos(2\pi t)$ $\quad h(t) = 4\,\mathrm{sinc}(4t)$

$w(t) = 2\cos(4\pi t)$ $\quad f(t) = 2\,\mathrm{sinc}(2t)$ $\quad T_c = 1\ s$

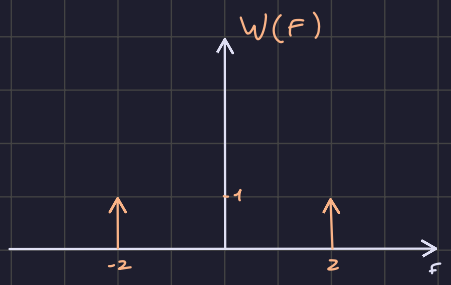
$u(t) = 3\cos(2\pi 3t) + \cos(2\pi t) \xrightarrow{F} U(f) = \frac{3}{2}\delta(f-3) + \frac{3}{2}\delta(f+3) + \frac{1}{2}\delta(f-1) + \frac{1}{2}\delta(f+1)$

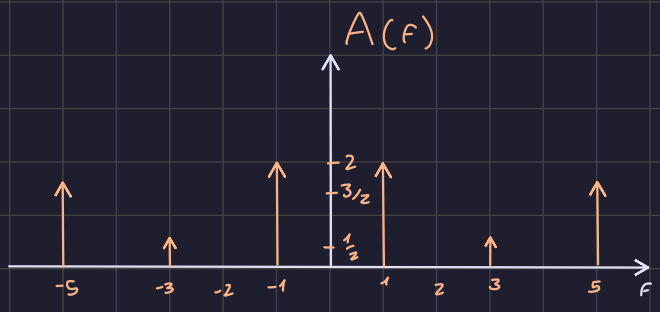
$w(t) = 2\cos(2\pi 2t) \xrightarrow{F} W(f) = \delta(f-2) + \delta(f+2)$

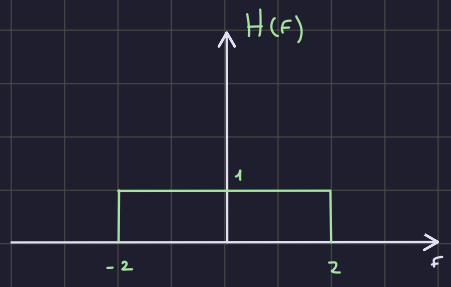
$h(t) = 1.4\,\mathrm{sinc}(4t) \xrightarrow{F} H(f) = \Pi\left(\frac{f}{4}\right)$

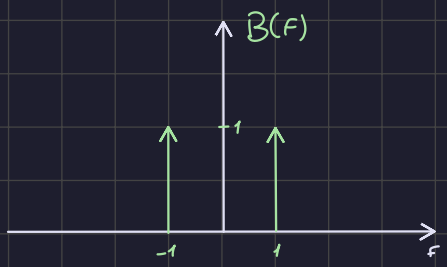
$f(t) = 1.2\,\mathrm{sinc}(2t) \xrightarrow{F} F(f) = \Pi\left(\frac{f}{2}\right)$

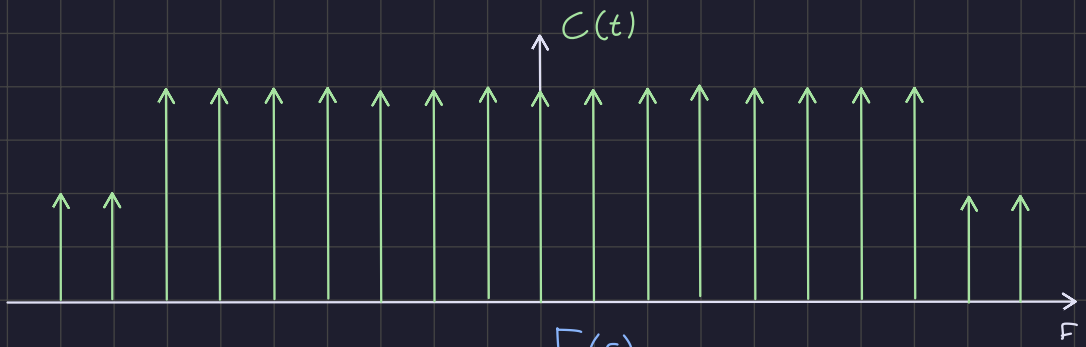
$T_c = 1s \rightarrow f_c = \frac{1}{T_c} = 1\ Hz$

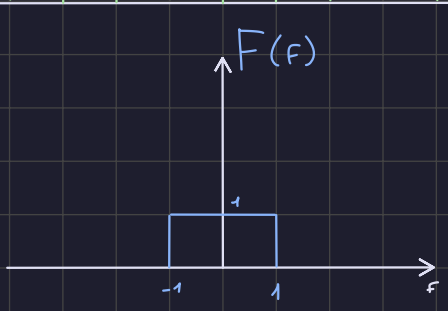


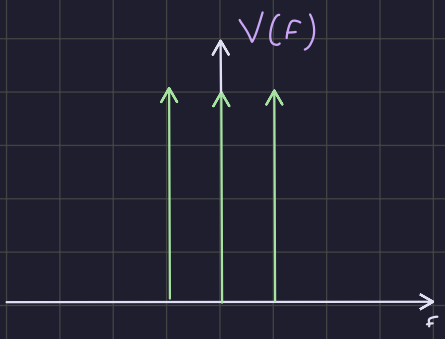












$$V(f) = 4(\delta(f-1) + \delta(f+1) + \delta(f))$$

$$= 4(\delta(f-1) + \delta(f+1)) + 4\delta(f)$$

$$\downarrow F^{-1}$$

$$v(t) = 8\cos(2\pi t) + 4$$

Il fenomeno di aliasing si verifica perchè in questo caso $f_c \leq 2B$, dove $B = 1$, quindi il segnale si sovrappone impedendo così la ricostruzione.