Es. 1 - Si calcoli la risposta in frequenza equivalente H(f) del sistema in figura 1 sapendo che $H_1(f) = \exp(-j2\pi fT)$ e $H_2(f) = rect\left(\frac{f}{2B}\right)$. Si faccia il grafico della risposta in ampiezza per 1) T=0; 2) T=1/B.

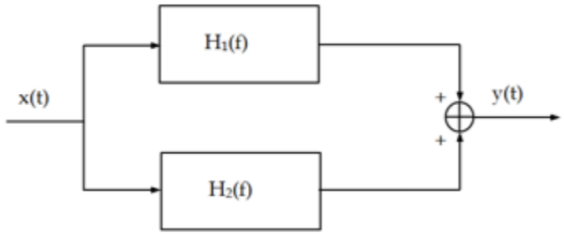


Fig. 1

$$y(t) = x(t) \otimes h_1(t) + x(t) \otimes h_2(t)$$

$$Y(f) = X(f)H_1(f) + X(f)H_2(f) = X(f)\left[H_1(f) + H_2(f)\right]$$

$$H(f) = \exp(-j2\pi fT) + rect\left(\frac{f}{2B}\right)$$

$$H(f) = \begin{cases} 1 + e^{-j2\pi fT} & \text{se } -B \leq f \leq B \\ e^{-j2\pi fT} & \text{altrimenti} \end{cases} = \begin{cases} 1 + \cos(2\pi fT) - j\sin(2\pi fT) \\ \cos(2\pi fT) - j\sin(2\pi fT) \end{cases}$$

$$|H(f)| = \begin{cases} \sqrt{H(f)H^*(f)} & \text{se } -B \leq f \leq B \\ 1 & \text{altrimenti} \end{cases}$$

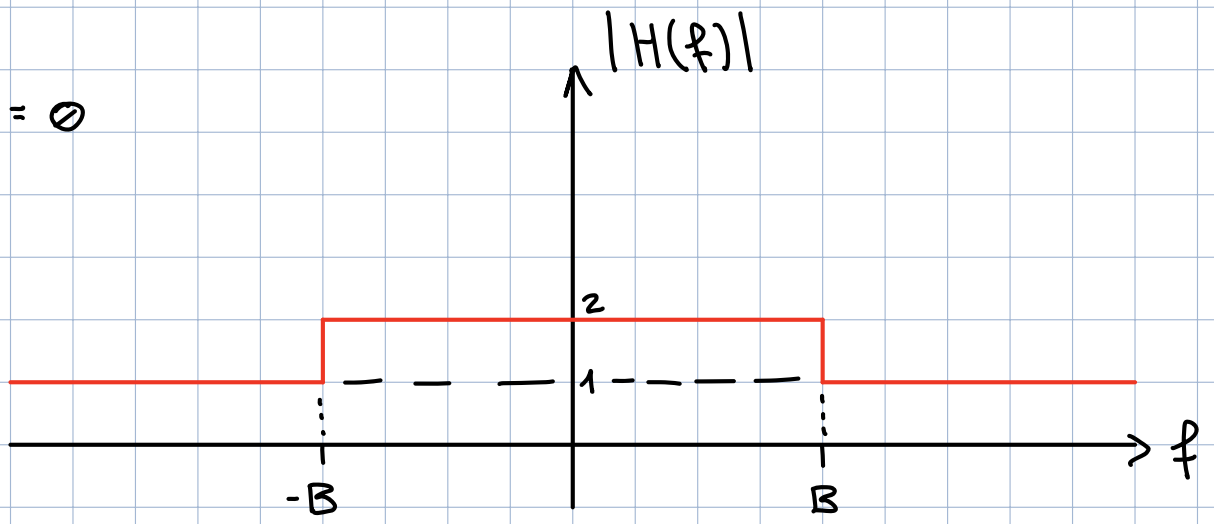
$$\sqrt{H(f)\,H^*(f)} = \sqrt{(1+e^{-j2\pi fT})(1+e^{j2\pi fT})} = \sqrt{2+e^{j2\pi fT}+e^{-j2\pi fT}}$$

$$= \sqrt{2+\cos(2\pi fT)+\cancel{j\sin(2\pi fT)}+\cos(2\pi fT)-\cancel{j\sin(2\pi fT)}}$$

$$= \sqrt{2[1+\cos(2\pi fT)]} = \sqrt{4\left[\tfrac{1}{2}+\tfrac{1}{2}\cos(2\pi fT)\right]} =$$

$$= 2\sqrt{\cos^2(\pi fT)} = 2|\cos(\pi fT)|$$

$|H(f)|$ se $T = 0$



$|H(f)|$ se $T = \frac{1}{B}$