FILA A

Es. 1

$$x(t) = \sum_n \mathrm{rect}\left(\frac{t - \frac{2}{B}n}{\frac{1}{2B}}\right) = \sum_n x_0(t - nT_0)$$

$$x_0(t) = \mathrm{rect}\left(\frac{t}{1/2B}\right)$$

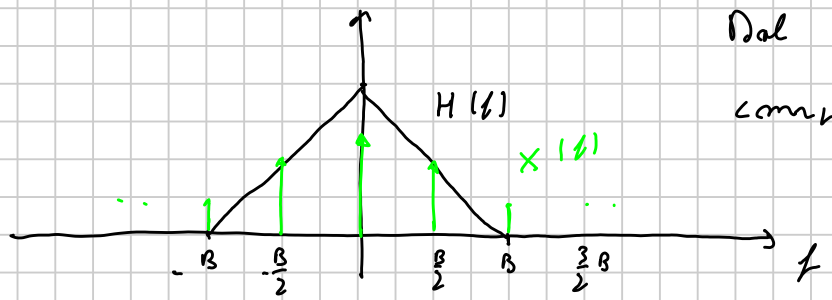
$$T_0 = \frac{2}{B}$$

$$X_0(f) = \frac{1}{2B}\,\mathrm{sinc}\left(\frac{f}{2B}\right)$$

$$X(f) = \frac{1}{T_0}\sum_k X_0\left(\frac{k}{T_0}\right)\delta\left(f - \frac{k}{T_0}\right) =$$

$$= \frac{B}{2}\sum_k \frac{1}{2B}\,\mathrm{sinc}\left(k\frac{B}{2}\frac{1}{2B}\right)\delta\left(f - k\frac{B}{2}\right)$$

$$h(t) = B\,\mathrm{sinc}^2(Bt) \rightleftarrows H(f) = \left(1 - \frac{|f|}{B}\right)\mathrm{rect}\left(\frac{f}{2B}\right)$$



Dal filtro passano le componenti per $k = 0, \pm 1$

$$X_0 = \frac{1}{4} \qquad X_1 = X_{-1} = \frac{1}{4}\,\mathrm{sinc}\left(\frac{1}{4}\right) = \frac{1}{4}\,\frac{4}{\pi}\sin\left(\frac{\pi}{4}\right) = \frac{1}{\pi}\frac{\sqrt{2}}{2}$$

$$Y(f) = \frac{1}{4}\delta(f) + \underbrace{\frac{1}{2}}_{H\left(\frac{B}{2}\right)}\frac{\sqrt{2}}{2\pi}\delta\left(f - \frac{B}{2}\right) + \underbrace{\frac{1}{2}}_{H\left(\frac{B}{2}\right)}\frac{\sqrt{2}}{2\pi}\delta\left(f + \frac{B}{2}\right)$$

$$y(t) = \frac{1}{4} + \frac{\sqrt{2}}{2\pi}\cos\left(2\pi\frac{B}{2}t\right)$$

$$P_y = \frac{1}{16} + \frac{2}{16\pi^2} + \frac{2}{16\pi^2} = \frac{\pi^2 + 4}{16\pi^2} \qquad E_y = \infty$$

Es. 2

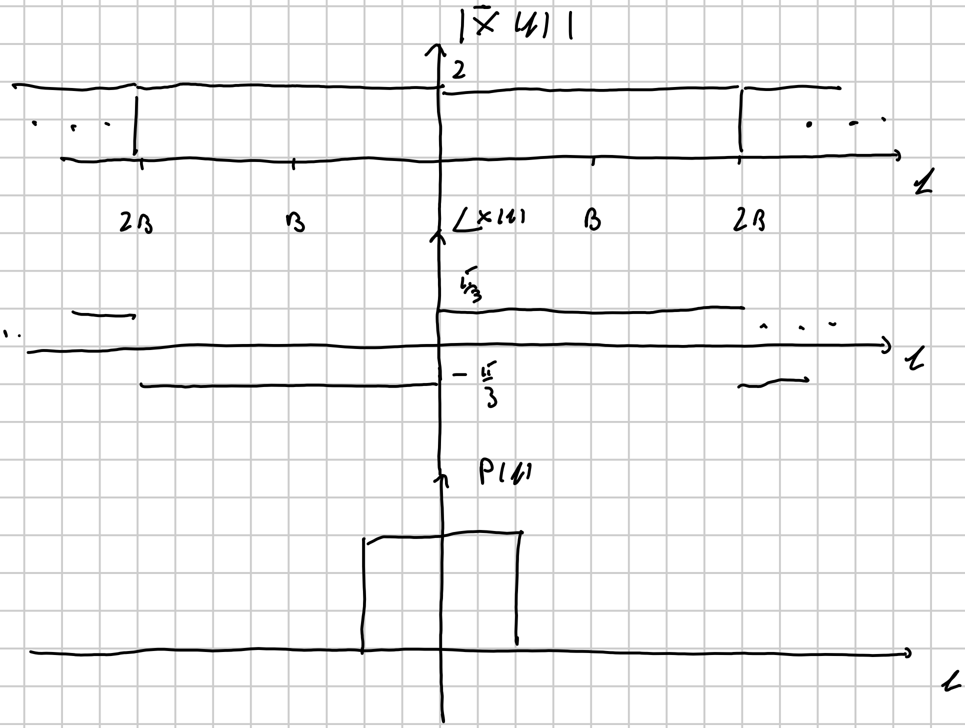
$$x(t) = 2\,\mathrm{sinc}(2Bt)\cos\left(2\pi Bt + \frac{\pi}{3}\right)$$

$$X(f) = \frac{1}{2B}\,\mathrm{rect}\left(\frac{f}{2B}\right) \otimes \left(\delta(f-B)\,e^{j\pi/3} + \delta(f+B)\,e^{-j\frac{\pi}{3}}\right) =$$

$$= \frac{1}{2B}\,\mathrm{rect}\left(\frac{f-B}{2B}\right) e^{j\pi/3} + \frac{1}{2B}\,\mathrm{rect}\left(\frac{f+B}{2B}\right) e^{-j\frac{\pi}{3}}$$

$$p(t) = B\,\mathrm{sinc}(Bt) \rightleftharpoons P(f) = \mathrm{rect}\left(\frac{f}{B}\right)$$

$$\bar{X}(f) = \frac{1}{T_c}\sum_n X\left(f - \frac{n}{T_c}\right) \qquad T_c = \frac{1}{4B}$$



$$Y(f) = 2\,\mathrm{rect}\left(\frac{f - B/4}{B/2}\right) e^{j\pi/3} + 2\,\mathrm{rect}\left(\frac{f + B/4}{B/2}\right) e^{-j\pi/3}$$

$$y(t) = 2B\,\mathrm{sinc}\left(\frac{B}{2}t\right)\cos\left(2\pi\frac{B}{4}t + \frac{\pi}{3}\right)$$

$$E_y = 4B \qquad P_y = 0$$

Es. 3

$$T[\cdot] = \int_a^t x(\alpha - t_1)\, d\alpha$$

- LINEARE sì

$$T[c_1 x_1(t) + c_2 x_2(t)] = \int_a^t \left(c_1 x_1(\alpha - t_1) + c_2 x_2(\alpha - t_1) \right) d\alpha =$$

$$= c_1 \int_a^t x_1(\alpha - t_1)\, d\alpha + c_2 \int_a^t x_2(\alpha - t_1)\, d\alpha$$

- CAUSALE sì

È uscita dipende solo da istanti passati

- STAZIONARIO NO

$$T[x(t - t_0)] \overset{?}{=} y(t - t_0)$$

$$\beta = \alpha - t_0$$

$$\int_a^t x(\alpha - t_1 - t_0)\, d\alpha = \int_{a - t_0}^{t - t_0} x(\beta - t_1)\, d\beta \neq$$

$$\neq y(t - t_0) = \int_a^{t - t_0} x(\alpha)\, d\alpha$$

CON MEMORIA sì

l'uscita a t dipende da istanti precedenti