Soluzione

$$x(t) \overset{TCF}{\Longleftrightarrow} X(f)$$

$$X(f) = X_1(f) + X_2(f) \quad , \quad X_1(f) = 3\left(1 - \frac{|f|}{3B}\right) \mathrm{rect}\left(\frac{f}{6B}\right)$$

$$X_2(f) = -2\left(1 - \frac{|f|}{2B}\right) \mathrm{rect}\left(\frac{f}{4B}\right)$$

$$x(t) = x_1(t) + x_2(t) \quad , \quad x_1(t) \overset{TCF}{\Longleftrightarrow} X_1(f) \quad , \quad x_2(t) \overset{TCF}{\Longleftrightarrow} X_2(f)$$

$$x_1(t) = 9B\ \mathrm{sinc}^2(3Bt) - 4B\ \mathrm{sinc}^2(2Bt)$$

$$\xrightarrow{x(t)} \boxed{h(t)} \longrightarrow y(t)$$

$$Y(f) = X(f)\,H(f) = H(f)$$

$$y(t) = h(t) \overset{TCF}{\Longleftrightarrow} H(f)$$

$$y(t) = h(t) = 3B\ \mathrm{sinc}(3Bt) \otimes \left[\delta(t) + \frac{\alpha}{2}\delta\left(t - \frac{1}{f_0}\right) + \frac{\alpha}{2}\delta\left(t + \frac{1}{f_0}\right)\right] \otimes \delta\left(t - \frac{1}{2B}\right)$$

$$= 3B\ \mathrm{sinc}\left[3B\left(t - \frac{1}{2B}\right)\right] + \frac{3}{2}\alpha B\ \mathrm{sinc}\left[3B\left(t - \frac{1}{f_0} - \frac{1}{2B}\right)\right] + \frac{3}{2}\alpha B\ \mathrm{sinc}\left[3B\left(t + \frac{1}{f_0} - \frac{1}{2B}\right)\right]$$

$$E_y = \int_{-\infty}^{+\infty} |H(f)|^2\, df = \int_{-\frac{3}{2}B}^{\frac{3}{2}B} \left[1 + \alpha\cos(2\pi f/f_0)\right]^2 df =$$

$$= \int_{-\frac{3}{2}B}^{\frac{3}{2}B} \left[1 + \alpha^2\cos^2(2\pi f/f_0) + 2\alpha\cos(2\pi f/f_0)\right] df =$$

$$= 3B + \frac{\alpha^2}{2} 3B = \left(3 + \frac{3}{2}\alpha^2\right) B$$

Nota che $\displaystyle\int_{-\frac{3}{2}B}^{\frac{3}{2}B} 2\alpha\cos(2\pi f/f_0)\, df \simeq 0$ essendo $f_0 \ll B$

$\displaystyle\int_{-\frac{3}{2}B}^{\frac{3}{2}B} \frac{\alpha^2}{2}\cos(4\pi f/f_0)\, df \simeq 0$ " "