Soluzione es. 2 del 27/06/2017

1) $$E_s = \frac{1}{2}\left(E[x_c^2] + E[x_s^2]\right)E_p$$

$$E[x_c^2] = \frac{2}{3}(-2)^2 + \frac{1}{3}(2)^2 = \frac{8}{3} + \frac{4}{3} = \frac{12}{3} = 4$$

$$E[x_s^2] = \frac{1}{2}(-1)^2 + \frac{1}{2}(1)^2 = 1$$

$$E_p = \int_{-\infty}^{+\infty} P^2(f)\,df = \frac{1}{T}$$

$$E_s = \frac{1}{2}\cdot(4+1)\frac{1}{T} = \frac{5}{2T}$$

2) $$P_{n_{u,c}} = N_0 E_{h_R} = N_0 E_p = \frac{5N_0}{2T}$$

$$P_{n_{u,s}} = P_{n_{u,c}}$$

3) verifica assenza di ISI

$$H(f) = P(f)H_R(f) = \left(1 - |fT|\right)\mathrm{rect}\left(\frac{fT}{2}\right)$$

$$h(t) = \frac{1}{T}\mathrm{sinc}^2\left(\frac{t}{T}\right) \Rightarrow h(nT) = \begin{cases} 1/T & n=0 \\ 0 & n\neq 0 \end{cases}$$

$\Rightarrow$ ASSENZA DI ISI

$$h(0) = \frac{1}{T}$$

Non è presente cross-talk, per cui posso applicare la seguente:

$$P_E(n) = P_{E,C}(b)\left(1 - P_{E,S}(b)\right) + P_{E,S}(b)\left(1 - P_{E,C}(b)\right) + P_{E,C}(b)\,P_{E,S}(b)$$

$$P_{E,C}(b) = \frac{2}{3}\,Q\left(\frac{2/T}{\sqrt{\frac{5N_0}{2T}}}\right) + \frac{1}{3}\,Q\left(\frac{2/T}{\sqrt{\frac{5N_0}{2T}}}\right) = Q\left(\frac{2/T}{\sqrt{\frac{5N_0}{2T}}}\right)$$

$$P_{E,S}(b) = \frac{1}{2}\,Q\left(\frac{1/T}{\sqrt{\frac{5N_0}{2T}}}\right) + \frac{1}{2}\,Q\left(\frac{1/T}{\sqrt{\frac{5N_0}{2T}}}\right) = Q\left(\frac{1/T}{\sqrt{\frac{5N_0}{2T}}}\right)$$