1) $P[y>0] = P[x_1 x_2 > 0] = P[x_1>0, x_2>0] + P[x_1<0, x_2<0]$

$\underset{\substack{\uparrow \\ \text{indip.}}}{=} P[x_1>0]\, P[x_2>0] + P[x_1<0] \cdot P[x_2<0]$

$f_x(e)$ è simmetrica $\Rightarrow \quad P[x_1>0] = \frac{1}{2}$

$P[y>0] = \frac{1}{2}$

2) $P_e = 0.1 \cdot P\left[n_k > \frac{V_0}{2}\right] + 0.1\, P\left[n_k < -\frac{V_0}{2}\right]$

$+0.8\; P\left[\,|n_k| > \frac{V_0}{2}\right]$

$= 0.2\, Q\left(\frac{V_0}{\sigma_n \cdot 2}\right) + 0.8 \cdot 2 \cdot Q\left(\frac{V_0}{\sigma_n \cdot 2}\right)$

$= 1.8\; Q(50)$

3)
$\overline{R}_v(f) = \left|\frac{1}{T} \cdot G(f)\right|^2 \cdot R_e(f)$; $\quad m_e = 0$

$R_e(f) = \sigma_e^2 \cdot T = 0.4T \qquad \sigma_e^2 = 0.4$

$G(f) = V_0 \cdot \int_0^{+\infty} e^{-\left(\frac{5}{T} + j2\pi f\right)t}\, dt$

$= \dfrac{V_0}{\frac{5}{T} + j2\pi f}$

$|G(f)|^2 = \dfrac{V_0^2}{\frac{25}{T^2} + 4\pi^2 f^2} \qquad \overline{R}_v(f) = \dfrac{V_0^2}{25 + 4\pi^2 T^2 f^2} \cdot 0.4T$

$\overline{M}_v = \int_{-\infty}^{+\infty} \overline{R}_v(f)\, df = 0.04\, V_0^2$

4.

$$L(f) = \frac{\frac{1}{j2\pi fC}}{R + \frac{1}{j2\pi fC}} = \frac{1}{1+j2\pi fRC}$$

Posto

$$H(f) = h_0 \cdot (1+j2\pi fRC) \cdot \mathrm{rect}\, \frac{f\cdot T}{(1+\alpha)}$$

si ha

$$C(f) = G(f) \cdot L(f) \cdot H(f) = h_0 \cdot G(f)$$

con andamento a coseno rialzato $\Rightarrow$ no ISI

$$\sigma^2 = \int_{-\infty}^{+\infty} R_0 |H(f)|^2 df = \int_{-(1+\alpha)f_N}^{(1+\alpha)f_N} R_0 \cdot h_0^2 \left(1+4\pi^2 f^2 (RC)^2\right) df$$

$$= R_0 h_0^2 \frac{(1+\alpha)}{T} + R_0 h_0^2 4\pi^2 (RC)^2 \cdot \frac{1}{3} \cdot 2 (1+\alpha)^3 f_N^3$$

5.

$$n_c(hT) = T \sum_{k=0}^{+\infty} 0.5^k\, n(hT-kT) \qquad m_{n_c} = 0$$

$$R_{nc}(f) = R_n(f) \cdot |H(f)|^2 = R_0 |H(f)|^2$$

$$M_{nc} = \int_0^{\frac{1}{T}} R_{nc}(f)\, df = \int_0^{\frac{1}{T}} R_0 |H(f)|^2 df = R_0 \cdot T \cdot \sum_{k=0}^{+\infty} h^2(kT)$$

$$= R_0 T \sum_{k=0}^{+\infty} ((0.5)^2)^k = \frac{R_0 T}{1-\frac{1}{4}} = \frac{4}{3} R_0 T$$