Es. 1

$m_a = 0 \qquad \eta_a = \sigma_a^2 = \frac{1}{4}(9+1+1+9) = 5$

$R_a(f) = \sigma_a^2 \cdot T = 5T$

$\bar{R}_y(f) = R_a(f) \cdot |H(f)|^2$

$H(f) = \mathcal{F}\left[\text{rect}\frac{t}{T}\right] = T\,\text{tri}(fT)$

$\bar{R}_y(f) = 5T^3\,\text{tri}^2(fT)$

$\bar{\eta}_y = \int_{-\infty}^{+\infty} \bar{R}_y(f)\,df = 5T^3 \cdot 2 \cdot \frac{1}{3T} = \frac{10}{3}T^2$

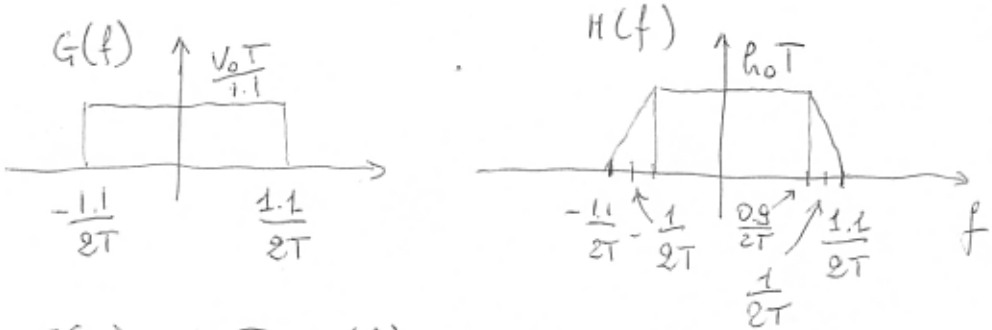
Es 2

$\eta_a = 2\int_0^V \left(a - \frac{V}{2}\right)^2 \frac{a}{V^2}\,da = \frac{V^2}{12}$

Es. 3

Con una banda di 8 MHz è possibile trasmettere fino a 8 Msimboli/s. Ogni simbolo trasmette $\log_2 16 = 4$ bit. Il bitrate massimo risulta 32 Mbit/s

Es. 4

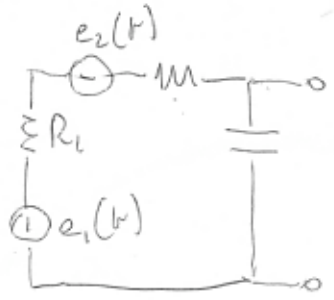


$C(f) = \frac{V_0 T}{1.1} H(f)\,; \quad c(t) = \frac{V_0 h_0 T}{1.1}\,\text{sinc}\frac{t}{T}\,\text{sinc}\left(\frac{0.1\,t}{T}\right)$

$c(t)$ è di Nyquist con $c(0) = V_0' = \frac{V_0 h_0 T}{1.1}$

$\sigma_n^2 = \int_{-\infty}^{+\infty} R_0 \cdot |H(f)|^2 df = R_0\left(h_0^2 T^2 \frac{0.9}{T} + 2\,h_0^2 T^2 \frac{0.2}{2T}\cdot\frac{1}{3}\right); \quad P_e = Q\left(\frac{V_0'}{\sigma_n}\right)$

Es 5.



$$W = (E_1 + E_2)\ \frac{\frac{1}{j2\pi f C}}{R_1 + R_2 + \frac{1}{j2\pi f C}}$$

$$R_W(f) = \frac{(2kT_1R_1 + 2kT_2R_2)}{1 + 4\pi^2 f^2 C^2 (R_1+R_2)^2}$$