

Solution of Homework # 2

1. As shown in class, the average bit error probability P_b of the polar NRZ scheme in terms of the amplitude a and the bit duration T_b is given by

$$P_b = Q \left(\sqrt{\frac{2a^2 T_b}{N_0}} \right). \quad (1)$$

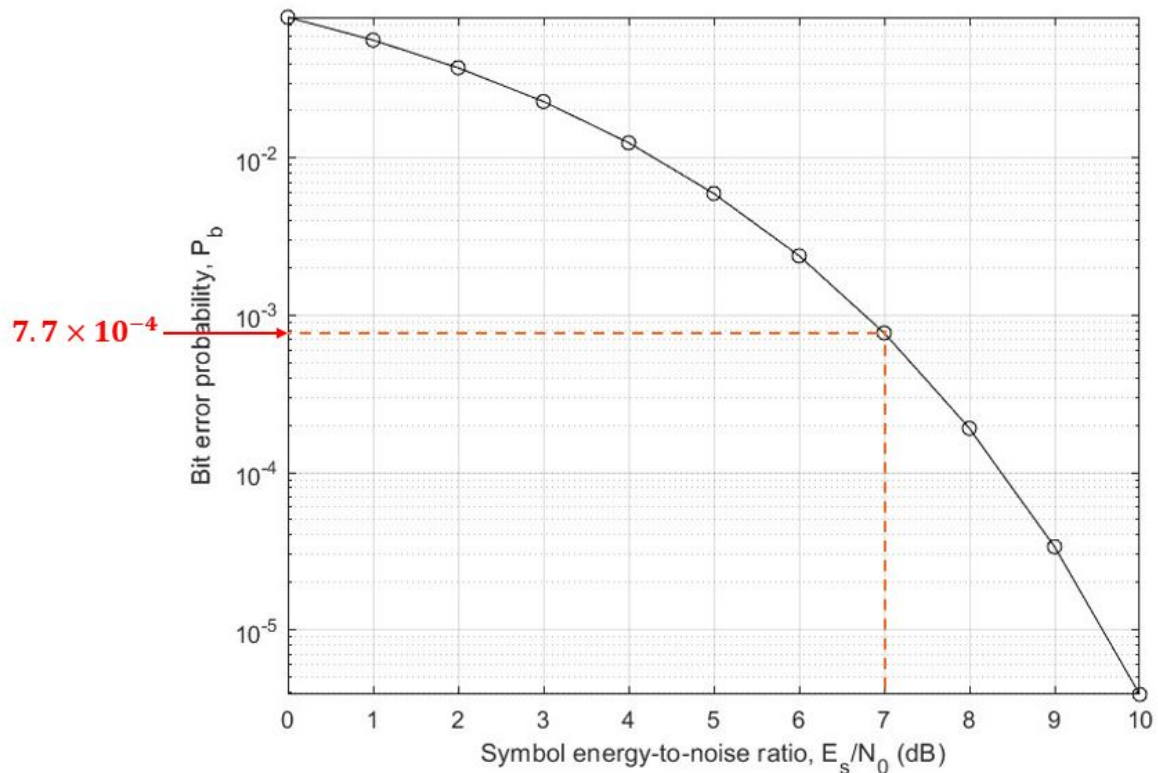
We have $N_0 = 3 \times 10^{-21}$, $P_b = 10^{-2}$ and $T_b = 1/R_b = 10^{-8}$. From equation (1),

$$a = Q^{-1}(10^{-2}) \sqrt{\frac{3 \times 10^{-13}}{2}} = \underline{0.9 \mu\text{V}}.$$

2. Wireless ASK performance at 7 dB

(a) $P_b = Q \left(\sqrt{2 \frac{E_b}{N_0}} \right) = Q \left(\sqrt{2 \times 10^{7/10}} \right) = \underline{7.7 \times 10^{-4}}.$

(b) Verification:

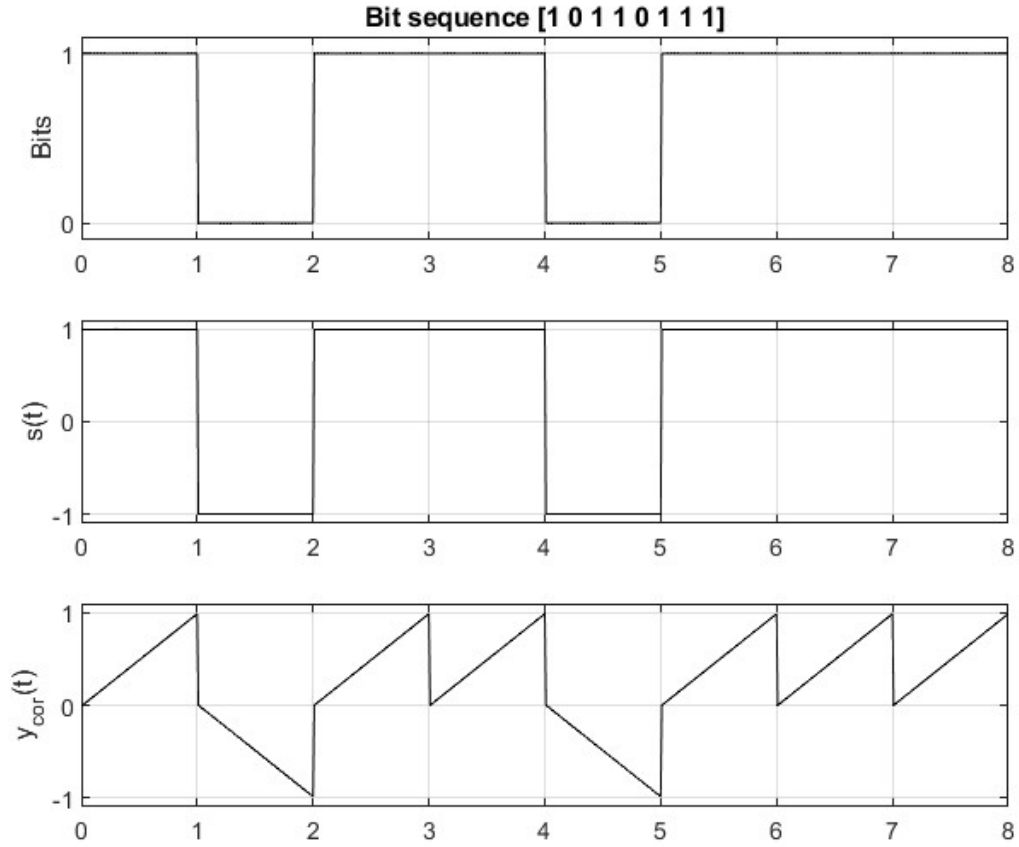


3. Wireless OOK link at $P_b = 10^{-3}$

Use the expression of the average bit error probability

$$P_b = Q\left(\sqrt{\frac{E_b}{N_0}}\right) \rightarrow \frac{E_b}{N_0} = [Q^{-1}(10^{-3})]^2 = 9.55 \text{ or } \underline{9.8 \text{ dB}}.$$

4. Polar NRZ signal and correlator output for bit sequence [1 0 1 1 0 1 1 1]



5. Simulation results using ID number 112233:

