CSE 4214 :: Problem Set 3

1. Let
$$h[k] = \begin{cases} k+1, & 0 \leq k \leq 4 \\ 0 & \text{otherwise} \end{cases} . \tag{1}$$
If this is the matched filter, find the optimal $s_0[k]$, $s_1[k]$, z, and the probability of error in terms of N_0 and erfc.

2. Suppose in polar NRZ, a synchronization error occurs, and the matched filter output is taken at times $kn_b - \epsilon$, for some positive $\alpha < n_b$. That is,
$$s_0 = [s_0[k] \star h[k]]_{n_b - \epsilon} , \tag{2}$$
and similarly for s_1. Find the probability of error as a function of n_b and α.

3. Suppose $s_0[k] = \alpha s_1[k]$. For constant E_b, show that $\Pr(\mathsf{error})$ is minimum when $\alpha = -1$.

4. Let $n_b = 8$. If
$$s_0[k] = \begin{cases} sin(2\pi k/n_b), & 1 \leq k \leq n_b \\ 0 & \text{otherwise} \end{cases} \tag{3}$$
and
$$s_0^*[k] = \begin{cases} \gamma, & 1 \leq k \leq n_b \\ 0 & \text{otherwise} \end{cases} , \tag{4}$$
and assuming equiprobable input symbols and optimal system design, find γ such that the energy per bit is the same in both modulation schemes.