ECE 642 - Assignment 7

1. You have been asked to build a digital communication system that transmits $K_b = 3$ bits of information. The specification given to you by your supervisor is to achieve at least a $R_b = 1$ Mbits/s transmission rate.

a. Specify a set of waveforms that will transmit $K_b = 3$ bits with a transmission rate $R_b = 1$ Mbits/s.

b. What is the spectral efficiency of your design in at point a?

2. Consider binary transmission $(K_b = 1)$ with the waveforms

$$
\begin{aligned}
x_{z,1}(t) &= A\operatorname{sinc}(t) \\
x_{z,0}(t) &= -A\operatorname{sinc}(t)
\end{aligned}
$$

a. Find A as a function of E_b, $\pi_0 = \Pr[M = 0]$ and $\pi_1 = \Pr[M = 1]$.

b. Assume that a rectangular filter

$$
H(f) = \begin{cases} 1 & \text{if } -1 \le f \le 1 \\ 0 & \text{otherwise} \end{cases}
$$

is applied by the baseband demodulator. Evaluate m_0, m_1 and $\sigma_{N_I}^2$ as a function of E_b and N_0. To compute m_0 and m_1, set the sampling time to time zero (Why does this choice make sense here?).

c. Based on the results above, evaluate the optimal bit decision using MAPBD when the sufficient statistic is $V_I = 0.1$ and we set the system parameters as $E_b = 1$, $N_0 = 0.1$ and $\pi_0 = 0.5$.

d. How large should π_0 be so that the optimal decision is $\hat{M} = 0$?