Problems

1. Find the capacity of an AWGN channel with a bandwidth B = 1 MHz, signal power of 10W and noise power-spectral density of N0/2 = 10^{-9} W/Hz.

2. Find the capacity of a telephone channel with bandwidth W=3000Hz, and SRN of 39 dB.

3. A binary channel matrix is given by

$$\begin{array}{cc} & \text{Outputs} \\ & \begin{array}{cc} y_1 & y_2 \end{array} \\ \text{Inputs} \begin{array}{c} x_1 \\ x_2 \end{array} & \begin{pmatrix} \frac{2}{3} & \frac{1}{3} \\ \frac{1}{10} & \frac{9}{10} \end{pmatrix} \end{array}$$

   This means $P_{y|x}(y_1|x_1) = 2/3$, $P_{y|x}(y_2|x_1) = 1/3$, etc. You are also given that $P_x(x_1) = 1/3$ and $P_x(x_2)=2/3$. Determine $H(x)$, $H(x|y)$, $H(y)$, $H(y|x)$, and $I(x;y)$. and what is the channel capacity?

4. The 4-bit sequence x is coded by the linear block codes defined by the following parity check matrix, with $d_{min}=3$:

$$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

   After transmission, the sequence r = 1000111 is demodulated. What can you say about x?