UNIVERSITY OF TEXAS AT DALLAS
Department of Electrical Engineering

EE 6391 - Signaling and Coding for Wireless Communication Systems
Problem Set #6: Digital Modulation

Date assigned: April 14, 2005
Date due: April 21, 2005

Homework is due at the beginning of class. Late homework will not be accepted.

Reading: The Art of Signaling: Fifty Years of Coding Theory. A. Calderbank, IEEE Trans. on Info Theory. Oct. 1998.

You may use any computer program to help you solve these problems, check answers, etc.

Problem 6.1

The generator matrix for a linear binary code is

$$\mathbf{G} = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

(a) Express $\mathbf{G}$ in the systematic $[\mathbf{I}|\mathbf{P}]$ form.

(b) Determine the parity check matrix $\mathbf{H}$ for the code.

(c) Construct the table of syndromes for the code.

(d) Determine the minimum distance of the code.

(e) Demonstrate that the codeword corresponding to the information sequence 101 is orthogonal to $\mathbf{H}$.

Problem 6.2

Assume you have a Rayleigh fading channel with a Doppler of 80 Hz and an average received SNR per bit of 15 dB. The system has coding and interleaving to compensate for the fading. The encoder uses a 5-repetition code (each bit is repeated 5 times) with majority decoding. If the coded bits are BPSK modulated and sent through the channel at 30 Kbps, what is the required interleaver dept (i.e. the number of rows at interleaver) to obtain independent fading on each codeword bit. What is the total interleaver delay and the probability of bit error after the majority decoding. Will this system work well for voice transmission? Give your reason.