Homework 2

EE/TE 4367: Telecommunications Networks

NOTE: Please, complete the following table and keep record of your assignment number.

| First Name |  |
| Last Name |  |
| Student ID |  |
| Assignment # | 0 |

**Exercise 1.** Consider an error detection system based on concurrent use of horizontal ($K$ bits per row) and vertical ($J$ bits per column) parity checks.

A) Find an example of a pattern of six errors that cannot be detected [pt. 10]. [Hint: each row with errors and each column with errors will contain exactly two errors.]

**Exercise 2.** Consider an error detection system based on concurrent use of horizontal ($K$ bits per row) and vertical ($J$ bits per column) parity checks.

A) Find the total number of different patterns of four errors that will not be detected [pt. 10]. [Hint: consider using a combinatorial approach.]

**Exercise 3.** Consider a parity check code with three data bits and four parity checks. Suppose that three of the code-words are: 1001011, 0101011, and 0011110.

A) Find the rule for generating each of the parity checks [pt. 10].

B) Find the set of all eight code-words [pt. 10].

C) What is the minimum distance of this code [pt. 10].

**Exercise 4.** Let $g(D) = D^4 + D^2 + D + 1$ be the generator polynomial of a CRC system, and let $s(D) = D^3 + D + 1$ be the polynomial describing the string of data bits to be transmitted.

A) Find the remainder when $D^4 s(D)$ is divided by $g(D)$, using modulo 2 arithmetic [pt. 10].

B) Find the complete string of bits to be transmitted, inclusive of data and CRC bits, starting left with the first bit to be transmitted [pt. 10].

**Exercise 5.** Consider a generator polynomial $g(D)$, which contains the factor $D + 1$.

A) Show that when using $g(D)$ to compute the CRC bits, any odd number of errors in the received string is detected [pt. 10]. [Hint: Recall that a non-zero error polynomial $e(D)$ is detected unless $e(D) = g(D)z(D)$ for some polynomial $z(D)$. Look at what happens if 1 is substituted for $D$ in this equation.]