

Assignment #3

No late assignments accepted!

ECE 487 (Data Communications Networks) **Section B1**

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Your Last Name: _____ Your First Name: _____

Your Student ID: _____

Due: Thursday, January 30, 2020, 4:00 PM, in the assignment box at 2nd Floor - Pedway between ICE and ETLC

1. For the following data bits organized in two rows and three columns, please add two-dimensional parity-check bits, and give the corresponding codeword. Over the transmission medium, the second bit in the second row is changed from bit '0' to bit '1'. Please describe how the receiver will process the received codeword. **(4 points)**

0 1 1
1 0 1

2. For the Hamming Code discussed in our Lecture 3, show how error correction is performed at the receiver for the following cases. It is required your error detection and correction should be based on the syndrome bits. **(6 points)**

i) Dataword: 0111; error pattern: 0100000

ii) Dataword: 0100; error pattern: 1000001

iii) Dataword: 0011; error pattern: 1101000

3. Consider a code (with 4 bits in a dataword and 7 bits in a codeword) using the following three redundant bits:

$$r_2 = a_2 + a_1 + a_0 \quad \text{modulo-2}$$

$$r_1 = a_3 + a_1 + a_0 \quad \text{modulo-2}$$

$$r_0 = a_3 + a_2 + a_1 \quad \text{modulo-2}$$

Note that the code could also be called a Hamming Code (not the same as the Hamming Code used in our Lecture 3).

(a) How does the receiver calculate the three syndrome bits? **(2 points)**

(b) The receiver assumes there is at most one bit error in the received codeword. The three-bit syndrome creates eight different bit patterns ("000" to "111"). For each bit pattern, please indicate which bit (among the seven bits in the received codeword) the receiver considers corrupted. **(2 points)**

Syndrome $S_2S_1S_0$	000	001	010	011	100	101	110	111
Corrupted bit								

(Question 4 is on the next page)

4. For the CRC code system with divisor "1011" discussed in Lecture 3, Denote the 4-bit dataword at the sender as $a_3a_2a_1a_0$, and the 7-bit codeword at the sender as $a_3a_2a_1a_0r_2r_1r_0$.
- (i) Give the codeword for dataword "1101". You are required to use division to get the codeword. **(2 points)**
 - (ii) For the codeword in (i), if bits a_2 , a_1 , and a_0 are corrupted during the transmission, give the syndrome bits at the receiver. Will the receiver accept the received codeword? **(2 points)**
 - (iii) Repeat question (ii) if bits a_1 , r_2 and r_1 are corrupted during the transmission. **(2 points)**