

Cpr E 489 Spring 2024

Homework #2

Due Date: 2/20/2024 (Tue) by 11:59 PM

Type or scan your answers and submit on Canvas

1. (30 points) Consider the same error detection code as in HW1, Q5 as follows. Two check bits are added to five information bits ( $i_4, i_3, i_2, i_1, i_0$ ). The first check bit  $c_1$  is the even parity check of the first two information bits ( $i_4, i_3$ ), and the second check bit  $c_0$  is the even parity check of the final three information bits ( $i_2, i_1, i_0$ ). The codeword is ( $i_4, i_3, i_2, i_1, i_0, c_1, c_0$ ).
  - a. (15 points) What fraction of error bursts of length 2 is undetectable by this code, i.e., what is  $FUE(L=2)$ ? Justify your answer.
  - b. (15 points) What fraction of error bursts of length 4 is undetectable by this code, i.e., what is  $FUE(L=4)$ ? Justify your answer.
2. (70 points) Consider a CRC code with a generator polynomial of  $g(x) = x^4 + x^3 + 1$ .
  - a. (10 points) Show the shift-register circuit that implements this CRC code.
  - b. (10 points) Show step by step (using the longhand division) how to find the codeword that corresponds to four information bits of 1110.
  - c. (10 points) Suppose the codeword length is 8. What fraction of errors is undetectable by this code, i.e., what is the overall FUE of this code? Justify your answer.
  - d. (10 points) Suppose the codeword length is 8. What fraction of error bursts of length 6 is undetectable by this code, i.e., what is  $FUE(L = 6)$  of this code? Justify your answer.
  - e. Suppose the codeword length is 8. Answer the following questions, with proper justifications.
    - i. (10 points) Give an example error vector of undetectable error burst of length 6 ( $L = 6$ ).
    - ii. (10 points) Give an example error vector of undetectable 6-bit error ( $M = 6$ ).
    - iii. (10 points) Give an example error vector of undetectable error that is both a 5-bit error and an error burst of length 8 ( $M = 5$  and  $L = 8$ ).