ELEX 7860 : Wireless System Design
2020 Winter Term

MIDTERM EXAM 2

1:30 PM – 2:20 PM
March 5, 2020

This exam has two (2) questions on two (2) pages. The marks for each question are as indicated. There are a total of nine (9) marks. Answer all questions. Write your answers and all rough work in this paper and nowhere else. Show your work. Draw a box around your final answer. Numerical answers must include units. Books and notes are allowed. No electronic devices other than calculators are allowed. **Show your work.**

This exam paper is for:

Exam 1 A00123456

Each exam is equally difficult.

Answer your own exam.

Do not start until you are told to do so.

Name: ______________________

BCIT ID: ______________________

Signature: ______________________

Question	Mark	Max.
1		4
2		5
Total		9

Question 1 — 4 marks

A flash memory device contains cells that are subject to random errors when read. FEC is used to correct these errors. The parity bits stored with the data decrease the information capacity of the memory.

A flash memory device contains a total of 10^6 memory cells, including those used for parity bits. The probability that a 'one' is read as a zero or that a 'zero' is read as a one are both 2^{-8}.

What is the maximum amount of information that could be stored in this memory and still achieve an arbitrarily small error rate?

Hints: Consider that reading from the memory is similar to transmitting data over a channel. You can assume the data being read is random and that zeros and ones are equally likely (i.e. each bit read contains 1 bit of information).

Question 2 — 5 marks

The parity check matrix, H, for a $(7, 4)$ Hamming code is:

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

(a) What are n, k and $n - k$?

(b) What codeword would be transmitted if the k data bits are $[0, 0, 1, 1]$?

255

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Exam 2 A00123456

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Question	Mark	Max.
1		4
2		5
Total		9

Question 1 — 4 marks

A flash memory device contains cells that are subject to random errors when read. FEC is used to correct these errors. The parity bits stored with the data decrease the information capacity of the memory.

A flash memory device contains a total of 10^6 memory cells, including those used for parity bits. The probability that a 'one' is read as a zero or that a 'zero' is read as a one are both 2^{-10}.

What is the maximum amount of information that could be stored in this memory and still achieve an arbitrarily small error rate?

Hints: Consider that reading from the memory is similar to transmitting data over a channel. You can assume the data being read is random and that zeros and ones are equally likely (i.e. each bit read contains 1 bit of information).

Question 2 — 5 marks

The parity check matrix, H, for a $(7, 4)$ Hamming code is:

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

(a) What are n, k and $n - k$?

(b) What codeword would be transmitted if the k data bits are $[1, 1, 0, 0]$?