

FINAL EXAM
1:00 PM – 4:00 PM
December 13, 2018

This exam has eight (8) questions on four (4) pages. The marks for each question are as indicated. There are a total of twenty-eight (28) 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
3		3
4		3
5		3
6		3
7		3
8		4
Total		28

Question 1**4 marks**

The Unicode code point for LATIN CAPITAL LETTER WYNN (\mathfrak{P}) is **U+01F7**.

- (a) How many bytes are required to transmit this character using the UTF-8 encoding?
- (b) What are the values of those bytes? Give your answer in hexadecimal.

Question 2**5 marks**

Draw the waveform that would be used to transmit the byte value **0x72** over an RS-232 asynchronous serial interface at a rate of 1200 bps with 7 bits per character, even parity and one stop bit. Show the complete waveform including start and stop bits.

Label the voltage axis with the minimum allowed voltage levels at the transmitter in units of volts. Indicate the duration of one bit along the time axis in units of microseconds .

Question 3**3 marks**

Draw the waveform that would be used to transmit the bit sequence 1, 0, 0, 1, 1 using an MLT-3 line code assuming an initial voltage level of +1 V. Include this initial bit in your drawing. Label the vertical (voltage) axis (only). Do *not* apply the 4B5B line code.

Question 4**3 marks**

A communication system receives a signal that has noise added to it. The noise has a mean (DC) voltage of 0 V and an RMS (AC) voltage of 88 mV. The communication system makes an error whenever the noise voltage is less than (more negative than) -200 mV. What is the probability of error?

Question 5**3 marks**

A binary symmetric channel (BSC) has an error rate of $p = 1 \times 10^{-3}$. What is the maximum error-free information rate that can be transmitted over this channel if the channel is used 1000 times per second (i.e. we can transmit, with errors, at 1 kbps). *Hint:* $\log_2(p) \approx -10$.

Question 6**3 marks**

An FEC code uses only two codewords: 1001 and 0110.

- (a) What is the minimum distance of this code?
- (b) How many errors per codeword is this code guaranteed to detect?
- (c) How many errors per codeword is this code guaranteed to correct?

Question 7**3 marks**

The initial bytes of an Ethernet frame, in hexadecimal and not including the preamble, are as follows:

`00 1d 7e 2f b5 9b 08 00 27 da fa 8f 08 00 ...`

Answer the following questions:

- (a) What is the source address?
- (b) What is the destination address?
- (c) What protocol is used by the payload? Give the Ethertype in hexadecimal.

Question 8**4 marks**

- (a) A communication system uses differential voltage signalling with two voltage levels. You measure the two voltages relative to ground as -10 V and $+5$ V. What is:
 - (i) The common-mode voltage?
 - (ii) The (absolute value of the) differential voltage?
- (b) A ML PRBS is generated using a circuit that contains 11 flip-flops. What is the longest continuous sequence of ones in the generated bit sequence?
- (c) A system uses ARQ over a link that has a long delay relative to the packet duration but a very low error rate. What is the simplest ARQ mechanism that will provide a high throughput?

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This exam paper is for:

Exam 2 A00123456

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Name: _____

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Question	Mark	Max.
1		4
2		5
3		3
4		3
5		3
6		3
7		3
8		4
Total		28

Question 1**4 marks**

The Unicode code point for LATIN SMALL LETTER G WITH CARON (ě) is U+01E7.

- (a) How many bytes are required to transmit this character using the UTF-8 encoding?
- (b) What are the values of those bytes? Give your answer in hexadecimal.

Question 2**5 marks**

Draw the waveform that would be used to transmit the byte value 0x27 over an RS-232 asynchronous serial interface at a rate of 1200 bps with 7 bits per character, even parity and one stop bit. Show the complete waveform including start and stop bits.

Label the voltage axis with the minimum allowed voltage levels at the transmitter in units of volts. Indicate the duration of one bit along the time axis in units of microseconds .

Question 3**3 marks**

Draw the waveform that would be used to transmit the bit sequence 0, 1, 1, 0, 0 using an MLT-3 line code assuming an initial voltage level of +1 V. Include this initial bit in your drawing. Label the vertical (voltage) axis (only). Do *not* apply the 4B5B line code.

Question 4**3 marks**

A communication system receives a signal that has noise added to it. The noise has a mean (DC) voltage of 0 V and an RMS (AC) voltage of 44 mV. The communication system makes an error whenever the noise voltage is less than (more negative than) -100 mV. What is the probability of error?

Question 5**3 marks**

A binary symmetric channel (BSC) has an error rate of $p = 1 \times 10^{-3}$. What is the maximum error-free information rate that can be transmitted over this channel if the channel is used 1000 times per second (i.e. we can transmit, with errors, at 1 kbps). *Hint:* $\log_2(p) \approx -10$.

Question 6**3 marks**

An FEC code uses only two codewords: 1100 and 0011.

- (a) What is the minimum distance of this code?
- (b) How many errors per codeword is this code guaranteed to detect?
- (c) How many errors per codeword is this code guaranteed to correct?

Question 7**3 marks**

The initial bytes of an Ethernet frame, in hexadecimal and not including the preamble, are as follows:

`08 00 27 da fa 8f 00 1d 7e 2f b5 9b 08 00 ...`

Answer the following questions:

- (a) What is the source address?
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- (c) What protocol is used by the payload? Give the Ethertype in hexadecimal.

Question 8**4 marks**

- (a) A communication system uses differential voltage signalling with two voltage levels. You measure the two voltages relative to ground as -5 V and $+10$ V. What is:
 - (i) The common-mode voltage?
 - (ii) The (absolute value of the) differential voltage?
- (b) A ML PRBS is generated using a circuit that contains 12 flip-flops. What is the longest continuous sequence of ones in the generated bit sequence?
- (c) A system uses ARQ over a link that has a long delay relative to the packet duration but a very low error rate. What is the simplest ARQ mechanism that will provide a high throughput?

