

FINAL EXAM
13:00 – 16:00
Thursday, December 12, 2019
SW9-122

This exam has eight (8) questions on three (3) pages. The marks for each question are as indicated. There are a total of thirty-three (33) 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:

Sample Exam 1 A00000000

Each exam is equally difficult.

Answer your own exam.

Do not start until you are told to do so.

Name: _____

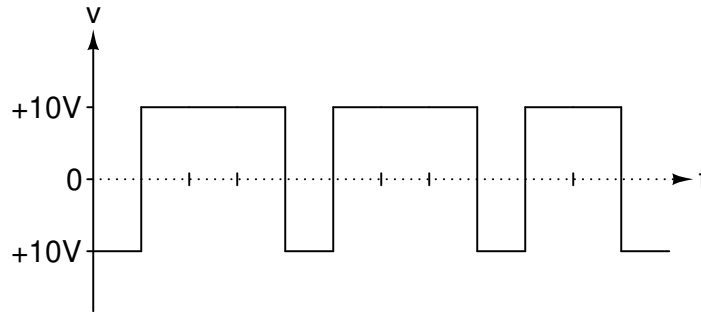
BCIT ID: _____

Signature: _____

Question	Mark	Max.
1		5
2		4
3		4
4		3
5		3
6		3
7		4
8		7
Total		33

Question 1**5 marks**

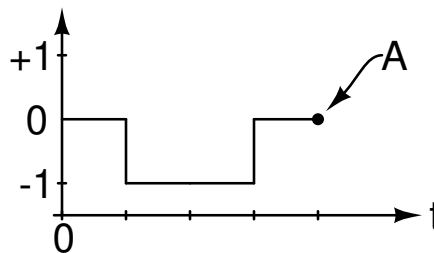
The following RS-232 waveform is used to transmit one character using eight (8) data bits:



- What is the value, in hexadecimal, of that character? Show how you obtained your answer.
- What character is being transmitted (write the letter)?
- Is there a parity bit? If so, is even or odd parity being used?

Question 2**4 marks**

The following waveform is encoded using the MLT-3 line code only (without 4B5B).



- If the previous signal level was 0 (zero) and each division along the time axis is one bit duration, what sequence of bit values was transmitted between time 0 and point A?
- Draw the waveform, starting at the time and voltage labelled A above that would be used to transmit the following additional bits: 1,0,0,1. Mark the start point of your waveform as A.

Question 3**4 marks**

The 4-bit message 1100, corresponding to the polynomial $x^3 + x^2$, is to be protected by a CRC computed as the remainder after dividing this polynomial by the generator polynomial $x^2 + 1$.

- What is the length of the CRC in bits?
- What is the value of the CRC? Show your work.

Question 4**3 marks**

A Gaussian noise source has a mean of zero volts and an RMS voltage of 120 mV. What fraction of the time is the noise voltage greater than 200 mV?

Question 5**3 marks**

The following sequence of bits contains an HDLC frame. What are the values of the bits included in the frame? Omit bits outside the frame, the HDLC flag sequences, and any bit-stuffing within a frame.

0 0 0 0 1 1 1 1 1 1 0 1 0 1 1 1 1 1 0 1 0 0 0 1 1 1 1 1 1 0

Question 6**3 marks**

An FEC code uses three six-bit codewords: 110000, 001100 and 000011.

- (a) What is the minimum distance of this code?¹
- (b) What is the maximum number of errors per codeword that this code guaranteed to detect?
- (c) What is the maximum number of errors per codeword that this code guaranteed to correct?

Question 7**4 marks**

- (a) The signal power at the output of an AWGN (Additive White Gaussian Noise) channel is 50 dBm and the noise power is 40 dBm. What is the SNR in dB?
- (b) If the bandwidth of this channel is 20 MHz, what is the maximum information rate that can be transmitted over this channel with an arbitrarily low error rate?

Question 8**7 marks**

- (a) The DSR pin on an RS-232 interface is an output and is at a level of +9 V.
 - (i) Is this connector wired as a DTE or DCE? How do you know?
 - (i) Is the signal asserted or not (i.e. is the Data Set Ready or not)? Why?
- (b) A signal goes from -5 V to $+5$ V in 600 ns. What is the slew rate?

¹Remember to show your work for this and other questions.

- (c) A communication system uses differential signaling on two connectors labelled TD+ and TD-. You measure the voltages with respect to ground and find TD+ reads +9 V and TD- reads +5 V. What are the absolute values of the common-mode and differential voltages?
- (d) What is the period of a maximal-length pseudo-random bit sequence (ML PRBS) that contains 512 '1' (one) bits and 511 '0' (zero) bits?

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This exam paper is for:

Sample Exam 2 A00000000

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Answer your own exam.

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Name: _____

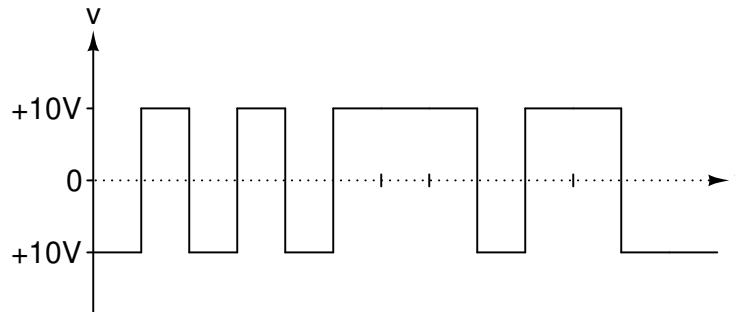
BCIT ID: _____

Signature: _____

Question	Mark	Max.
1		5
2		4
3		4
4		3
5		3
6		3
7		4
8		7
Total		33

Question 1**5 marks**

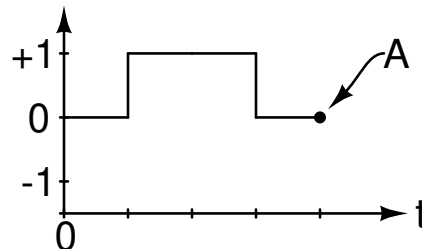
The following RS-232 waveform is used to transmit one character using eight (8) data bits:



- What is the value, in hexadecimal, of that character? Show how you obtained your answer.
- What character is being transmitted (write the letter)?
- Is there a parity bit? If so, is even or odd parity being used?

Question 2**4 marks**

The following waveform is encoded using the MLT-3 line code only (without 4B5B).



- If the previous signal level was 0 (zero) and each division along the time axis is one bit duration, what sequence of bit values was transmitted between time 0 and point A?
- Draw the waveform, starting at the time and voltage labelled A above that would be used to transmit the following additional bits: 0,1,1,0. Mark the start point of your waveform as A.

Question 3**4 marks**

The 4-bit message 1110, corresponding to the polynomial $x^3 + x^2 + x$, is to be protected by a CRC computed as the remainder after dividing this polynomial by the generator polynomial $x^2 + 1$.

- What is the length of the CRC in bits?
- What is the value of the CRC? Show your work.

Question 4**3 marks**

A Gaussian noise source has a mean of zero volts and an RMS voltage of 60 mV. What fraction of the time is the noise voltage greater than +100 mV?

Question 5**3 marks**

The following sequence of bits contains an HDLC frame. What are the values of the bits included in the frame? Omit bits outside the frame, the HDLC flag sequences, and any bit-stuffing within a frame.

0 0 0 0 1 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0 1 0 0 1 1 1 1 1 1 0

Question 6**3 marks**

An FEC code uses three six-bit codewords: 110000, 001100 and 000011.

- (a) What is the minimum distance of this code?¹
- (b) What is the maximum number of errors per codeword that this code guaranteed to detect?
- (c) What is the maximum number of errors per codeword that this code guaranteed to correct?

Question 7**4 marks**

- (a) The signal power at the output of an AWGN (Additive White Gaussian Noise) channel is 40 dBm and the noise power is 30 dBm. What is the SNR in dB?
- (b) If the bandwidth of this channel is 10 MHz, what is the maximum information rate that can be transmitted over this channel with an arbitrarily low error rate?

Question 8**7 marks**

- (a) The DTR pin on an RS-232 interface is an output and is at a level of +9 V.
 - (i) Is this connector wired as a DTE or DCE? How do you know?
 - (i) Is the signal asserted or not (i.e. is the Data Terminal Ready or not)? Why?
- (b) A signal goes from -5 V to +5 V in 400 ns. What is the slew rate?

¹Remember to show your work for this and other questions.

- (c) A communication system uses differential signaling on two connectors labelled TD+ and TD-. You measure the voltages with respect to ground and find TD+ reads +7 V and TD- reads +3 V. What are the absolute values of the common-mode and differential voltages?
- (d) What is the period of a maximal-length pseudo-random bit sequence (ML PRBS) that contains 1024 '1' (one) bits and 1023 '0' (zero) bits?