ELEX 3525 : Data Communications
Term 201710

FINAL EXAMINATION
10:30 AM – 13:20 PM
April 20, 2017

This exam has seven (7) questions on eight (8) pages. The marks for each question are as indicated. There are a total of 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: _____

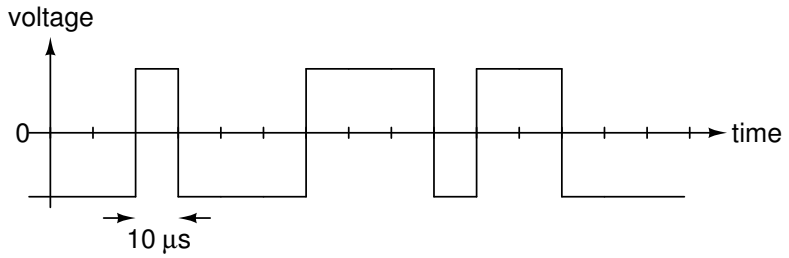
BCIT ID: _____

Signature: _____

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

Question 1 (5 marks)

The following waveform is used to transmit one character over an asynchronous serial ("RS-232") interface. The interface transmits 8 data bits per character.



(a) What is the bit rate?

(b) What is the baud rate?

(c) What is the hexadecimal value of the character transmitted?

(d) Is parity being used? If so, is it odd or even?

(e) Was an ASCII character transmitted? If so, which character (write the character)?

Question 2 (4 marks)

A section of 75Ω coaxial cable uses 16-gauge (AWG) center conductor and a foamed polyethylene dielectric with a dielectric constant (relative permittivity) of 1.5.

(a) What is the diameter of the center conduction in mm?

(b) What is the shield diameter in mm?

(c) How long does it take a signal to travel 100 m along this transmission line?

Question 3 (3 marks)

A 1 kHz sine wave is applied to the input of an amplifier. The power levels of the output frequency components are determined to vary as:

$$P_n = \frac{P_0}{2^n}$$

for $n = 0 \ldots 3$ where P_0 represents the power of the 1 kHz output and P_n is the power of the component at frequency $n+1$ kHz. The powers of the other harmonics are negligible (assume zero).

A notch filter at the filter output removes the 1 kHz component. The sum of the remaining harmonic powers ($P_1 + P_2 + P_3$) is measured to be 100 mW.

(a) What is the output power at 1 kHz (P_0)?

(b) What is the Total Harmonic Distortion (THD) of the amplifier?

Question 4 (3 marks)

An MLT-3 line code is used to transmit the bits 01101at 100 Mb/s. Draw the output waveform assuming the outputs during the two previous bit intervals were -1 V and 0 V. Apply only the MLT-3 encoding (not the 4B5B encoding). Label the voltage axis and the duration of one bit on the time axis.

Question 5 (4 marks)

A system computes CRCs by dividing the message, represented as a polynomial with coefficient from GF(2), by a 4-bit generator polynomial $G(x) = x^3 + 1$.

(a) What is the maximum length of the remainder (in bits)?

(b) If the message (not including the CRC) is 100, what is the value of CRC? Compute the CRC using the simple method described in the lectures, do not invert leading bits or the CRC.

Question 6 (4 marks)

A communication system uses a code with the following codewords:

110
011
000
101

(a) What is the minimum distance of this code? (show your work)

(b) If the channel introduces one error into a transmitted codeword (justify your answer *briefly*):

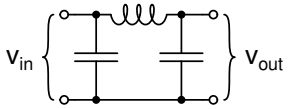
(i) Will the receiver be able to detect the error?

(ii) Will the receiver be able to correct the error?

Question 7 (5 marks)

(a) A system transmits at a data rate of 128 kbps and symbol rate of 32 kHz. (i) How many bits are transmitted per symbol? (ii) How many different symbols are required?

(b) The schematic below shows a filter. (i) Does it pass DC voltages? (ii) Does the attenuation increase or decrease with frequency? (iii) Is this a high-pass, low-pass or band-pass filter?



(c) A network with links between continents (e.g. 2000 km) operates at high speed (e.g. 10 Gb/s) fiber-optic links using relatively short (e.g. Ethernet-length) frames. A very small fraction of the frames (e.g. one per hour) are lost due to errors. What would be the most appropriate ARQ mechanism to use?

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This exam paper is for:

Exam 2 A00123456

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7		5
Total		28

Question 1 (5 marks)

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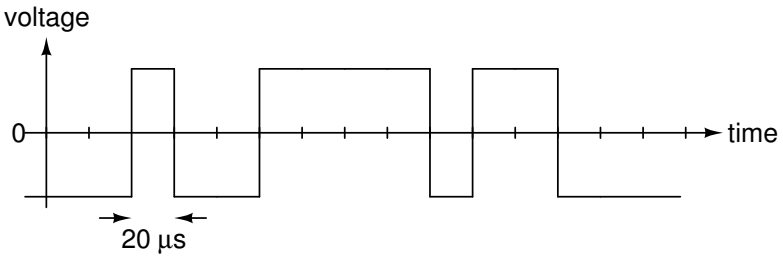

(a) What is the bit rate?

(b) What is the baud rate?

(c) What is the hexadecimal value of the character transmitted?

(d) Is parity being used? If so, is it odd or even?

(e) Was an ASCII character transmitted? If so, which character (write the character)?

Question 2 (4 marks)

A section of 50Ω coaxial cable uses 16-gauge (AWG) center conductor and a foamed polyethylene dielectric with a dielectric constant (relative permittivity) of 1.5.

(a) What is the diameter of the center conduction in mm?

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Question 3 (3 marks)

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A notch filter at the filter output removes the 1 kHz component. The sum of the remaining harmonic powers ($P_1 + P_2 + P_3$) is measured to be 100 mW.

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(b) What is the Total Harmonic Distortion (THD) of the amplifier?

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A system computes CRCs by dividing the message, represented as a polynomial with coefficient from GF(2), by a 4-bit generator polynomial $G(x) = x^3 + 1$.

(a) What is the maximum length of the remainder (in bits)?

(b) If the message (not including the CRC) is 111, what is the value of CRC? Compute the CRC using the simple method described in the lectures, do not invert leading bits or the CRC.

Question 6 (4 marks)

A communication system uses a code with the following codewords:

000
110
011
101

(a) What is the minimum distance of this code? (show your work)

(b) If the channel introduces one error into a transmitted codeword (justify your answer *briefly*):

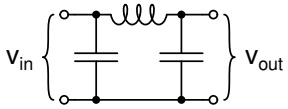
(i) Will the receiver be able to detect the error?

(ii) Will the receiver be able to correct the error?

Question 7 (5 marks)

(a) A system transmits at a data rate of 256 kbps and symbol rate of 64 kHz. (i) How many bits are transmitted per symbol? (ii) How many different symbols are required?

(b) The schematic below shows a filter. (i) Does it pass DC voltages? (ii) Does the attenuation increase or decrease with frequency? (iii) Is this a high-pass, low-pass or band-pass filter?



(c) A network with links between continents (e.g. 2000 km) operates at high speed (e.g. 10 Gb/s) fiber-optic links using relatively short (e.g. Ethernet-length) frames. A very small fraction of the frames (e.g. one per hour) are lost due to errors. What would be the most appropriate ARQ mechanism to use?