ELEX 3525 : Data Communications
Term 201630

FINAL EXAMINATION
10:30 AM – 1:30 PM
December 13, 2016

This exam has six (6) questions on twelve (12) pages. The marks for each question are as indicated. There are a total of 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:

Exam 1 A00123456

Each exam is equally difficult.
Answer your own exam.

Do not start until you are told to do so.

Name: _____

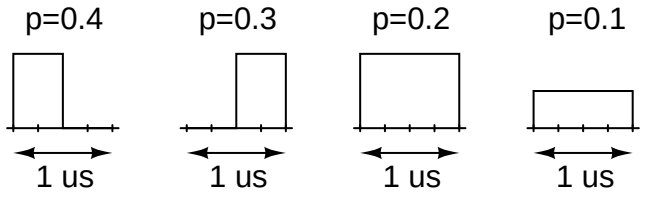
BCIT ID: _____

Signature: _____

Question	Mark	Max.
1		5
2		4
3		3
4		3
5		8
6		10
Total		33

Question 1 (5 marks)

A communication system transmits one of the following four symbols each microsecond. The probability of each symbol being transmitted is given above each symbol.



What is:

(a) The bit rate?

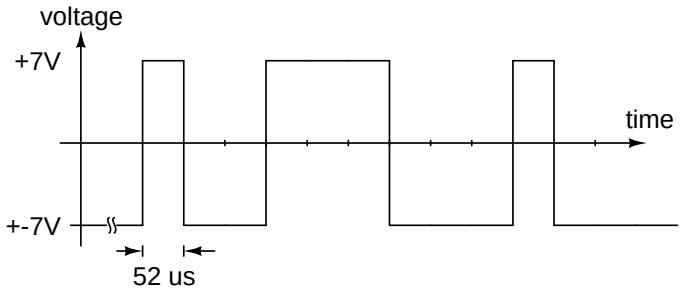
(b) The symbol rate?

(c) The information rate?

(d) The baud rate?

Question 2 (4 marks)

The following figure shows the transmission of one 8-bit value over an "RS-232" asynchronous serial interface.



(a) What value was transmitted? Give your answer in hexadecimal.

(b) What was the bit rate?

(c) Was parity used? If so which type (even or odd)?

Question 3 (4 marks)

A wireless link uses a frequency of 900 MHz, a transmit power of 1 W and antennas with gains of $G_T = G_R = 10$ dB. At what distance has the received power level dropped to $1\ \mu$W?

Question 4 (3 marks)

The message 011101 is received. It includes a CRC computed by dividing the original message by the generator polynomial $x^3 + x + 1$. Is there an error in the message? Show your work.

Question 5 (8 marks)

An FEC code uses the following four codewords:

```
000110
011011
101100
110001
```

(a) What are k, n and the code rate?

(b) What is the minimum Hamming distance of this code?

(c) How many channel errors is this code guaranteed to detect?

(d) How many channel errors is this code guaranteed to correct?

(e) If the codeword 100110 is received, did the channel introduce an error?

(f) If so, what codeword was most likely to have been transmitted?

(g) Is it possible the codeword 110001 was transmitted instead?

Question 6 (10 marks)

(a) What type of ARQ would be best suited for a communication system operating over a short distance and requiring low-cost hardware? Why?

(b) You are trying to connect two devices with serial interfaces but both devices appear to output data on the pin labelled RxD. What types of devices are these (DTE or DCE)? What simple hardware device could you use to allow these two devices to communicate?

(c) What is the maximum allowed cable length for a 10BaseT Ethernet link? If the dielectric constant of the cable is $\varepsilon_r = 0.66$, what is the (one-way) propagation delay over this length of cable?

(d) What is the minimum channel bandwidth required to transmit a 2 Mb/s NRZ signal without ISI? Sketch the (magnitude of the) frequency response of this channel.

(e) What passive electrical component is often used to implement a balun for use on twisted-pair links?

(f) Would the distortion of an audio amplifier be more likely to be measured using THD or IMD?

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This exam paper is for:

Exam 2 A00123456

Each exam is equally difficult.
Answer your own exam.

Do not start until you are told to do so.

Name: _____

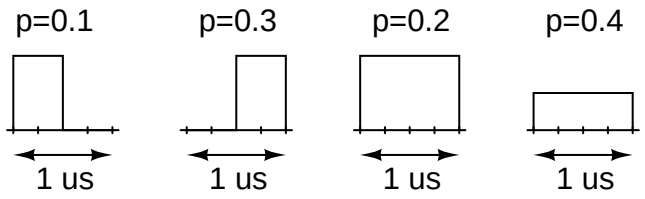
BCIT ID: _____

Signature: _____

Question	Mark	Max.
1		5
2		4
3		3
4		3
5		8
6		10
Total		33

Question 1 (5 marks)

A communication system transmits one of the following four symbols each microsecond. The probability of each symbol being transmitted is given above each symbol.



What is:

(a) The bit rate?

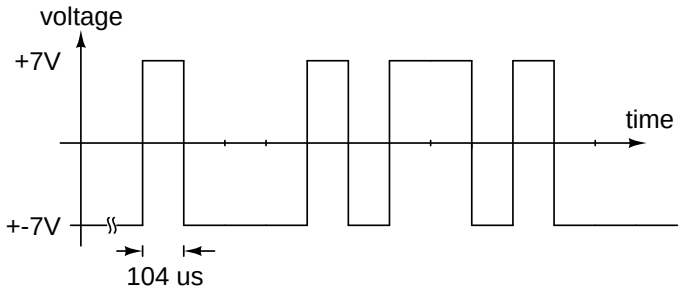
(b) The symbol rate?

(c) The information rate?

(d) The baud rate?

Question 2 (4 marks)

The following figure shows the transmission of one 8-bit value over an "RS-232" asynchronous serial interface.



(a) What value was transmitted? Give your answer in hexadecimal.

(b) What was the bit rate?

(c) Was parity used? If so which type (even or odd)?

Question 3 (4 marks)

A wireless link uses a frequency of 900 MHz, a transmit power of 10 W and antennas with gains of $G_T = G_R = 10$ dB. At what distance has the received power level dropped to $1\ \mu$W?

Question 4 (3 marks)

The message 011001 is received. It includes a CRC computed by dividing the original message by the generator polynomial $x^3 + x + 1$. Is there an error in the message? Show your work.

Question 5 (8 marks)

An FEC code uses the following four codewords:

```
000110
011011
101100
110001
```

(a) What are k, n and the code rate?

(b) What is the minimum Hamming distance of this code?

(c) How many channel errors is this code guaranteed to detect?

(d) How many channel errors is this code guaranteed to correct?

(e) If the codeword 111100 is received, did the channel introduce an error?

(f) If so, what codeword was most likely to have been transmitted?

(g) Is it possible the codeword 110001 was transmitted instead?

Question 6 (10 marks)

(a) What type of ARQ would be best suited for a communication system operating over a short distance and requiring low-cost hardware? Why?

(b) You are trying to connect two devices with serial interfaces but both devices appear to output data on the pin labelled TxD. What types of devices are these (DTE or DCE)? What simple hardware device could you use to allow these two devices to communicate?

(c) What is the maximum allowed cable length for a 10BaseT Ethernet link? If the dielectric constant of the cable is $\varepsilon_r = 0.66$, what is the (one-way) propagation delay over this length of cable?

(d) What is the minimum channel bandwidth required to transmit a 1 Mb/s NRZ signal without ISI? Sketch the (magnitude of the) frequency response of this channel.

(e) What passive electrical component is often used to implement a balun for use on twisted-pair links?

(f) Would the distortion of an audio amplifier be more likely to be measured using THD or IMD?