

Exam Version 0

A00123456

Each exam is equally difficult.  
Answer your own exam.

Do not start until you are told to do so.

- This page intentionally left blank. -

ELEX 3525 : Data Communications  
Term 201530

FINAL EXAMINATION

8:00 – 11:00 AM

January 11, 2016

*This exam has seven (7) questions on two (2) pages. Answer all questions, in any order. The marks for each question are as indicated. There are a total of 32 marks. Write your answers and all rough work in the exam book provided. Do not write anywhere else. Show your work. Underline or 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. Take this exam paper with you when you leave. Show your work.*

**Question 1** ( 8 marks)

The following sequence of bytes appears in a UTF-8 encoded data stream:

0x38 0xe3 0x81 0x99 0xd0 0x92

- (a) How many Unicode code points can be decoded?
- (b) What is the value of each code point? Give your answer in hexadecimal.
- (c) Which of these are also ASCII characters?

**Question 2** ( 5 marks)

Draw the waveform required to transmit the byte value 0x35 using 10 Mb/s Ethernet (Manchester encoding, little-endian bit order).

Show only the differential voltage, assuming TD+ and TD- each switch between 0 V and 1 V.

Draw the waveform to scale and label the time and voltage axes.

**Question 3** ( 5 marks)

A TV set receives a signal at a level of  $-40$  dBm.

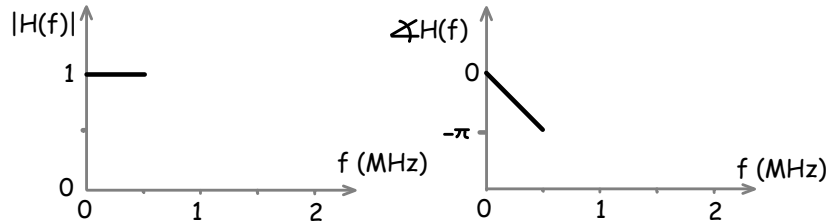
The TV transmitter has a transmit power of 10 kW and operates at a frequency of 600 MHz. The transmit antenna has a gain of 10 dB and the receiving antenna has a gain of 0 dB. The transmitting antenna is line-of-sight to the receiving antenna.

- (a) What is the received power in Watts?
- (b) How far is the receiver from the transmitter?

**Question 4 ( 3 marks)**

The following diagram shows part of a channel transfer function that causes no ISI to a signal with a symbol rate of 2 MHz. Draw the complete transfer function over the frequency range where  $|H(f)|$  is non-zero. Draw both the magnitude and phase responses and label the axes.

Write your answer in your answer booklet, not on this exam paper.



*Hints: you may assume the transmitted symbols are impulses. There may be more than one correct answer.*

**Question 5 ( 5 marks)**

The following data bytes are to be sent over a channel. Show the sequence of bytes that would be transmitted if using PPP framing with default options. You do not have to include a PPP header – only add what is required for framing and escaping the bytes shown below.

0x38 0x7d 0x1b 0xf0 0x50 0x7e

**Question 6 ( 3 marks)**

Compute a CRC using the algorithm described in the lecture notes for the 5-bit message “11111” assuming a generator polynomial of  $x^3 + x^1 + 1$ .

*Hint: You may assume the CRC is the remainder after dividing by the generator polynomial.*

**Question 7 ( 3 marks)**

A system uses bipolar NRZ signalling with levels of  $\pm 4$  V over an AWGN channel that has a noise variance ( $\sigma^2$ ) of  $2.5 \text{ V}^2$ . What is the BER?

# Exam Version 1

A00123456

Each exam is equally difficult.  
Answer your own exam.

Do not start until you are told to do so.

- This page intentionally left blank. -

ELEX 3525 : Data Communications  
Term 201530

FINAL EXAMINATION

8:00 – 11:00 AM

January 11, 2016

*This exam has seven (7) questions on two (2) pages. Answer all questions, in any order. The marks for each question are as indicated. There are a total of 32 marks. Write your answers and all rough work in the exam book provided. Do not write anywhere else. Show your work. Underline or 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. Take this exam paper with you when you leave. Show your work.*

**Question 1** ( 8 marks)

The following sequence of bytes appears in a UTF-8 encoded data stream:

0xd0 0x92 0xe3 0x81 0x99 0x33

- (a) How many Unicode code points can be decoded?
- (b) What is the value of each code point? Give your answer in hexadecimal.
- (c) Which of these are also ASCII characters?

**Question 2** ( 5 marks)

Draw the waveform required to transmit the byte value 0x35 using 10 Mb/s Ethernet (Manchester encoding, little-endian bit order).

Show only the differential voltage, assuming TD+ and TD- each switch between 0 V and 1 V.

Draw the waveform to scale and label the time and voltage axes.

**Question 3** ( 5 marks)

A TV set receives a signal at a level of  $-40$  dBm.

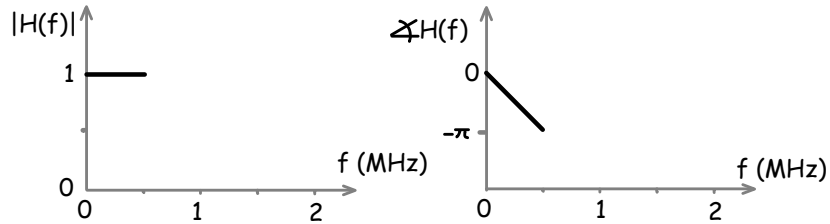
The TV transmitter has a transmit power of 10 kW and operates at a frequency of 300 MHz. The transmit antenna has a gain of 10 dB and the receiving antenna has a gain of 0 dB. The transmitting antenna is line-of-sight to the receiving antenna.

- (a) What is the received power in Watts?
- (b) How far is the receiver from the transmitter?

**Question 4 ( 3 marks)**

The following diagram shows part of a channel transfer function that causes no ISI to a signal with a symbol rate of 2 MHz. Draw the complete transfer function over the frequency range where  $|H(f)|$  is non-zero. Draw both the magnitude and phase responses and label the axes.

Write your answer in your answer booklet, not on this exam paper.



*Hints: you may assume the transmitted symbols are impulses. There may be more than one correct answer.*

**Question 5 ( 5 marks)**

The following data bytes are to be sent over a channel. Show the sequence of bytes that would be transmitted if using PPP framing with default options. You do not have to include a PPP header – only add what is required for framing and escaping the bytes shown below.

0x5f 0x7d 0x1b 0xc4 0x3d 0x7e

**Question 6 ( 3 marks)**

Compute a CRC using the algorithm described in the lecture notes for the 5-bit message “11111” assuming a generator polynomial of  $x^3 + x^1 + 1$ .

*Hint: You may assume the CRC is the remainder after dividing by the generator polynomial.*

**Question 7 ( 3 marks)**

A system uses bipolar NRZ signalling with levels of  $\pm 2$  V over an AWGN channel that has a noise variance ( $\sigma^2$ ) of  $0.64 \text{ V}^2$ . What is the BER?



# Exam Version 2

A00123456

Each exam is equally difficult.  
Answer your own exam.

Do not start until you are told to do so.

- This page intentionally left blank. -

ELEX 3525 : Data Communications  
Term 201530

FINAL EXAMINATION

8:00 – 11:00 AM

January 11, 2016

*This exam has seven (7) questions on two (2) pages. Answer all questions, in any order. The marks for each question are as indicated. There are a total of 32 marks. Write your answers and all rough work in the exam book provided. Do not write anywhere else. Show your work. Underline or 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. Take this exam paper with you when you leave. Show your work.*

**Question 1** ( 8 marks)

The following sequence of bytes appears in a UTF-8 encoded data stream:

0x38 0xe3 0x81 0x99 0xd0 0x92

- (a) How many Unicode code points can be decoded?
- (b) What is the value of each code point? Give your answer in hexadecimal.
- (c) Which of these are also ASCII characters?

**Question 2** ( 5 marks)

Draw the waveform required to transmit the byte value 0x53 using 10 Mb/s Ethernet (Manchester encoding, little-endian bit order).

Show only the differential voltage, assuming TD+ and TD- each switch between 0 V and 1 V.

Draw the waveform to scale and label the time and voltage axes.

**Question 3** ( 5 marks)

A TV set receives a signal at a level of  $-40$  dBm.

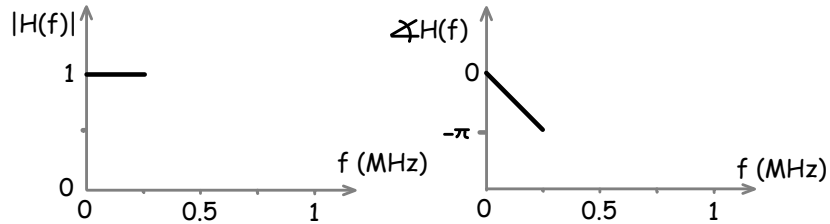
The TV transmitter has a transmit power of 10 kW and operates at a frequency of 600 MHz. The transmit antenna has a gain of 10 dB and the receiving antenna has a gain of 0 dB. The transmitting antenna is line-of-sight to the receiving antenna.

- (a) What is the received power in Watts?
- (b) How far is the receiver from the transmitter?

**Question 4 ( 3 marks)**

The following diagram shows part of a channel transfer function that causes no ISI to a signal with a symbol rate of 1 MHz. Draw the complete transfer function over the frequency range where  $|H(f)|$  is non-zero. Draw both the magnitude and phase responses and label the axes.

Write your answer in your answer booklet, not on this exam paper.



*Hints: you may assume the transmitted symbols are impulses. There may be more than one correct answer.*

**Question 5 ( 5 marks)**

The following data bytes are to be sent over a channel. Show the sequence of bytes that would be transmitted if using PPP framing with default options. You do not have to include a PPP header – only add what is required for framing and escaping the bytes shown below.

0x38 0x7d 0x1b 0xf0 0x50 0x7e

**Question 6 ( 3 marks)**

Compute a CRC using the algorithm described in the lecture notes for the 5-bit message “11111” assuming a generator polynomial of  $x^3 + x^2 + 1$ .

*Hint: You may assume the CRC is the remainder after dividing by the generator polynomial.*

**Question 7 ( 3 marks)**

A system uses bipolar NRZ signalling with levels of  $\pm 4$  V over an AWGN channel that has a noise variance ( $\sigma^2$ ) of  $2.5 \text{ V}^2$ . What is the BER?

# Exam Version 3

A00123456

Each exam is equally difficult.  
Answer your own exam.

Do not start until you are told to do so.

- This page intentionally left blank. -

ELEX 3525 : Data Communications  
Term 201530

FINAL EXAMINATION

8:00 – 11:00 AM

January 11, 2016

*This exam has seven (7) questions on two (2) pages. Answer all questions, in any order. The marks for each question are as indicated. There are a total of 32 marks. Write your answers and all rough work in the exam book provided. Do not write anywhere else. Show your work. Underline or 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. Take this exam paper with you when you leave. Show your work.*

**Question 1** ( 8 marks)

The following sequence of bytes appears in a UTF-8 encoded data stream:

0xd0 0x92 0xe3 0x81 0x99 0x33

- (a) How many Unicode code points can be decoded?
- (b) What is the value of each code point? Give your answer in hexadecimal.
- (c) Which of these are also ASCII characters?

**Question 2** ( 5 marks)

Draw the waveform required to transmit the byte value 0x53 using 10 Mb/s Ethernet (Manchester encoding, little-endian bit order).

Show only the differential voltage, assuming TD+ and TD- each switch between 0 V and 1 V.

Draw the waveform to scale and label the time and voltage axes.

**Question 3** ( 5 marks)

A TV set receives a signal at a level of  $-40$  dBm.

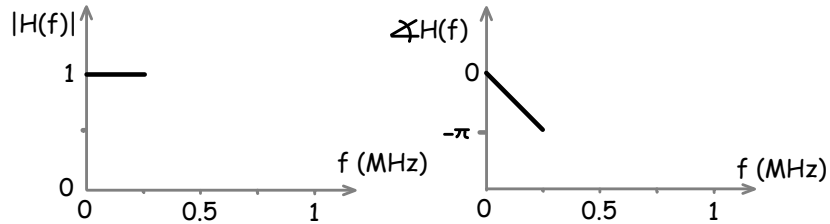
The TV transmitter has a transmit power of 10 kW and operates at a frequency of 300 MHz. The transmit antenna has a gain of 10 dB and the receiving antenna has a gain of 0 dB. The transmitting antenna is line-of-sight to the receiving antenna.

- (a) What is the received power in Watts?
- (b) How far is the receiver from the transmitter?

**Question 4 ( 3 marks)**

The following diagram shows part of a channel transfer function that causes no ISI to a signal with a symbol rate of 1 MHz. Draw the complete transfer function over the frequency range where  $|H(f)|$  is non-zero. Draw both the magnitude and phase responses and label the axes.

Write your answer in your answer booklet, not on this exam paper.



*Hints: you may assume the transmitted symbols are impulses. There may be more than one correct answer.*

**Question 5 ( 5 marks)**

The following data bytes are to be sent over a channel. Show the sequence of bytes that would be transmitted if using PPP framing with default options. You do not have to include a PPP header – only add what is required for framing and escaping the bytes shown below.

0x5f 0x7d 0x1b 0xc4 0x3d 0x7e

**Question 6 ( 3 marks)**

Compute a CRC using the algorithm described in the lecture notes for the 5-bit message “11111” assuming a generator polynomial of  $x^3 + x^2 + 1$ .

*Hint: You may assume the CRC is the remainder after dividing by the generator polynomial.*

**Question 7 ( 3 marks)**

A system uses bipolar NRZ signalling with levels of  $\pm 2$  V over an AWGN channel that has a noise variance ( $\sigma^2$ ) of  $0.64 \text{ V}^2$ . What is the BER?