Exam Version 0

A00123456

Each exam is equally difficult.
Answer your own exam.

Do not start until you are told to do so.

ELEX 4340: Data Communications
Term 201530

FINAL EXAMINATION
9:30 – 12:30 AM
January 12, 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 30 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 (4 marks)

A traffic light controller transmits one status message per second. There are four possible status messages: RG, RY, GR, and YR. The RG messages are sent 30 times per minute and the GR messages 20 times per minute. The RY and YR messages are each sent 5 times per minute.

(a) What is the probability of each message?

(b) What is the entropy of this source?

(c) What is the information rate of this source?

Question 2 (6 marks)

Draw the waveform required to transmit the ASCII character 's' (lower-case "es")using asynchronous serial signalling at a baud rate of 10 kb/s with 8 bits per character, one stop bit and no parity.

Assume an RS-422 interface where V+ and V− each switch between 0 V and 3 V but draw only the differential voltage. Assume this differential voltage follows the same polarity conventions as for an RS-232 serial interface.

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

Question 3 (6 marks)

The propagation delay through a 100 m section of co-ax cable is found to be 1 μs.

(a) What is the dielectric constant, ε_r, of the insulation between the center conductor and the shield?

(b) If the cable has a characteristic impedance of 50 Ω, what is the distributed capacitance between the center conductor and the shield? Give your answer in units of pF/m.

Hint: the velocity of light in free space is 3×10^8 m/s.

Question 4 (3 marks)

A deep-space probe uses powerful coding to achieve error-free communication over an AWGN channel even though the received SNR is -10 dB.

What is the minimum channel bandwidth required if the system operates at a rate of 2 kb/s?

Question 5 (4 marks)

The following bits are to be sent over a channel. Show the sequence of bits that would be transmitted using HDLC framing. You do not have to include an HDLC header – only add the bits required to frame and escape the bits shown below.

```
0 0 1 1 1 1 1 1 0 1
```

Question 6 (4 marks)

Compute the IP checksum for the following sequence of bytes:

```
20 04
10 03
f4 4f
18 28
00 00
```

Give your answer in hexadecimal. Show your work.

Question 7 (4 marks)

The following table shows a simplified IP routing table:

Destination	Netmask	Interface
127.0.0.0	255.255.0.0	lo
10.0.3.0	255.255.255.0	eth0
0.0.0.0	0.0.0.0	eth1

On what interface would IP packets with the following destination addresses be sent? As usual, show how you arrived at your answers (e.g. show some calculations).

(a) `10.0.3.255`

(b) `74.125.25.104`

(c) `10.0.5.1`

(d) `127.0.0.1`

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Draw the waveform required to transmit the ASCII character 'L' (capital "El")using asynchronous serial signalling at a baud rate of 10 kb/s with 8 bits per character, one stop bit and no parity.

Assume an RS-422 interface where V+ and V− each switch between 0 V and 5 V but draw only the differential voltage. Assume this differential voltage follows the same polarity conventions as for an RS-232 serial interface.

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(b) `74.125.25.104`

(c) `10.0.5.1`

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The propagation delay through a 100 m section of co-ax cable is found to be 1 μs.

  (a) What is the dielectric constant, ε_r, of the insulation between the center conductor and the shield?

  (b) If the cable has a characteristic impedance of 75 Ω, what is the distributed capacitance between the center conductor and the shield? Give your answer in units of pF/m.

Hint: the velocity of light in free space is 3×10^8 m/s.

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