This exam paper is for:

Each exam is equally difficult.
Answer your own exam.

Do not start until you are told to do so.

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ELEX 3525 : Data Communications
Term 201430

FINAL EXAMINATION
10:30 AM – 1:30 PM
January 6, 2015

*This exam has 7 (seven) questions on 2 (two) pages. The marks for each question are as indicated. There are a total of 27 marks. Answer all questions. Write your answers in the exam book provided. Show your work. Numerical answers must include units. You may answer the questions in any order. Books and notes are allowed. No electronic devices other than calculators are allowed. You may keep this exam paper.* Show your work.

**Question 1** ( 3 marks)

The Cyrillic character Ghe (Г) has a Unicode code point of U+0413 (hex 0x0413). How many octets (bytes) are required for the UTF-8 encoding? What are the values of those bytes in hex?

**Question 2** ( 4 marks)

Draw the RS-232 waveform that would be used to transmit the octet value 0x35 assuming 8 data bits, one stop bit and even parity. Label the voltage axis assuming voltage levels of $\pm$5V. Show the bit period assuming a bit rate of 19.2 kb/s.

**Question 3** ( 4 marks)

What is the velocity factor of an air-dielectric transmission line? What is the velocity of propagation in this transmission line? What is the inductance per meter if the capacitance per meter is 100 pF/m? What is the characteristic impedance of this transmission line?

**Question 4** ( 3 marks)

The signal from a space probe is received with an SNR of $-40$ dB. The communication system has a bandwidth of 1 MHz. What is the maximum error-free data rate you could hope to achieve?

**Question 5** ( 2 marks)

Bit stuffing is used to limit the number of consecutive zeros (0's) to 4 or fewer. You receive the sequence 1000101. What was the original bit sequence?

**Question 6** ( 3 marks)

Compute the CRC for the bit sequence 1001 using the generator polynomial $x^2 + x$.

**Question 7** ( 8 marks)

(a) A communication system uses an NRZ line code with a symbol period of 1 $\mu$s. Assuming an FEC rate-$\frac{1}{2}$ code with a frame error rate (FER) of $\frac{1}{2}$, what is the throughput? Assume other overhead (framing, multiplexing, etc.) is negligible.

(b) The communication system for toy's remote control has a short propagation delay and low implementation costs are very important. Which of the three ARQ techniques studied in the course would be most appropriate?

(c) What is the Hamming distance betwen the codewords 0010010 and 111000?

(d) Does the Ethernet address of an interface change depending on its location? Does the IP address of an interface change depending on its location?

(e) A communication system has multiple pairs in one cable bundle. All pairs transmit in the same direction. Is this system susceptible to NEXT, FEXT or both?

(f) For a Manchester line code what is the ratio of the baud rate to the bit rate?