This exam paper is for:

Extra Paper, A00123456

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 201330

FINAL EXAMINATION
9:30 AM – 12:30 PM
NE1-209
Tuesday, January 7, 2014

This exam has seven (7) questions on two (2) pages. The marks for each question are as indicated. There are a total of 36 marks. Answer all questions. Write your answers in the exam book provided. Show your work. You may answer the questions in any order. Books, notes and calculators are allowed. You may keep this exam paper.

Show your work.

Question 1 (7 marks)

Assuming UTF-8 encoding, how many glyphs (characters) are encoded by the following sequence of four bytes: `0xce`, `0x91`, `0xce`, and `0x92`? What are the values, in decimal, of their Unicode values ("code points")?

Table 3-6 from version 6.2 of the Unicode standard is given below.

Table 3-6. UTF-8 Bit Distribution

Scalar Value	First Byte	Second Byte	Third Byte	Fourth Byte
00000000 0xxxxxxx	0xxxxxxx			
00000yyy yyxxxxxx	110yyyyy	10xxxxxx		
zzzzyyyy yyxxxxxx	1110zzzz	10yyyyyy	10xxxxxx	
000uuuuu zzzzyyyy yyxxxxxx	11110uuu	10uuzzzz	10yyyyyy	10xxxxxx

Question 2 (4 marks)

A TV broadcasting satellite transmits 1 kW of power at 6 GHz using a transmit antenna with a gain of 50 dB. The receive antenna has a gain of 30 dB. The distance to the satellite is 38,000 km. What is the received power?

Question 3 (5 marks)

Show the RS-232 waveform that would be generated to transmit the ASCII value for the lowercase letter 'a' assuming a bit rate of 2400 bps, 8 data bits, one stop bit and no parity and voltage levels of ± 5 V. Show the two voltages on the y-axis and the duration of one bit on the x-axis.

Question 4 (2 marks)

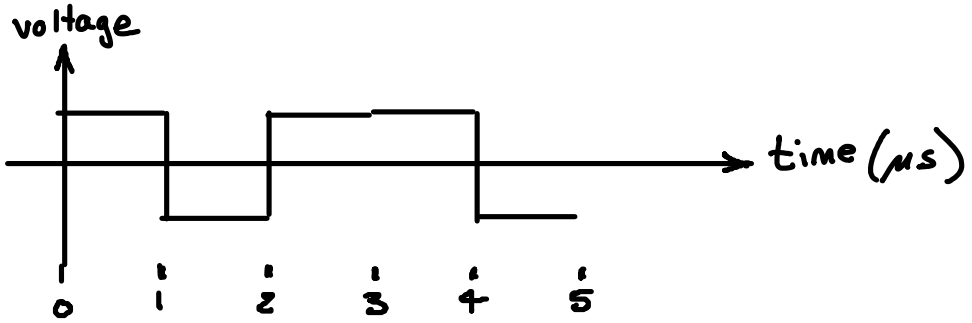
You would like to set up a communication link over a twisted pair cable running between two buildings. You measure the bandwidth as 50 kHz and the SNR as 30 dB. What is the highest useful data rate you could hope to achieve over this channel?

Question 5 (4 marks)

A communication system uses bipolar NRZ signalling with a 2 volt noise margin. What are the signal voltages? The channel adds white Gaussian noise. The SNR is 6 dB. What is the probability that the noise will cause an error? You may use the approximation formula in Assignment 3. Hint: σ^2 is the (normalized) noise power of Gaussian noise with standard deviation σ and v^2 is the (normalized) power of a signal of voltage v.

Question 6 (2 marks)

The following waveform represents a sequence of five bits encoded using an NRZI line code at a bit rate of 1 MHz. What are the values of the last four bits?



Question 7 (12 marks)

(a) a signal containing only two frequency components, one at 1 kHz and one at 2 kHz is input to a communication channel. At the output a component at a frequency of 3 kHz is detected. (i) Could this component be caused by linear distortion? (ii) Could it be caused by non-linear distortion? Explain *briefly*. (2 marks)

(b) a channel can be considered as an ideal low-pass channels with a bandwidth of 4 kHz. What is the maximum signalling rate in symbols/second that would result in no ISI? (2 marks)

(c) is the thermal noise generated by an RF amplifier random, pseudo-random or deterministic? (1 mark)

(d) arrange the following protocols in order from the lowest level to the highest level: IP, UDP, WiFi (a Wireless LAN protocol), HTTP. (2 marks)

(e) Ethernet frames generated by two network interfaces have source addresses: 00:24:1d:73:df:1c and 00:24:1d:48:c5:ce. Were the interfaces made by the same manufacturer? (1 mark)

(f) a one's-complement checksum computed according the IP protocol standard is used to protect four 16-bit values which have values 1, 2, 4, and 8. What is the value of the checksum in hexadecimal? (2 marks)

(g) is the IP address 173.188.165.93 in the network 173.188.128.0/17? (2 marks)