Assignment 2

Due Tuesday, March 20. Submit your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero. Show your work.

Question 1

Give the sequence of bytes in the UTF-8 encoding of the name of the Russian newspaper «Правда». Give your answer in hexadecimal. Explain or show how you arrived at your answer.

Question 2

USB 3.0 uses an 8B/10B block line code described in the Wikipedia 8b/10b article, among other places.

What data was transmitted if the following 20 bits were received? What was the running disparity (RD) before the first symbol? The bits are shown in time order with the first received bit leftmost. Give your answer in hexadecimal. Show your work.

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110101 1100   011000 0100
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Question 3

A system transmits differentially using two conductors. The voltage relative to ground on the first conductor is $2\sin(2\pi 100t)$ while the voltage on the other conductor relative to ground is $-1\cos(2\pi 100t)$.

(a) What is the common-mode signal?

(b) What is the differential signal?

Give each answer as an equation in the form $A\cos(2\pi ft + \theta)$ with the values of A, f and θ.

Question 4

An information source generates 8 different messages. The probability of the i'th message is $P_i \approx \frac{1}{2^i}$. The messages are transmitted over a channel at a rate of 10^6 messages per second.

(a) What is the entropy of the source in bits per message?

(b) What is the data rate over the channel, in bits per second, if each message is encoded using 3 bits per message?

(c) What is the data rate over the channel if the best possible compression method is applied before the data is transmitted over the channel?

Question 5

Four users share a communication channel that is divided into 100 μs time slots. One user uses half of the time slots and the other half of the time slots are shared equally between three low-priority users. 96 bits of useful data can be transmitted in each time slot. 10% of the slots contain errors and cannot be used. What throughput, in bits per second, do the three low-priority users see?