CPS 470/570: Exam 1 **Name:**____

Instructor: Dr. Clark September 21, 1995

This test is closed book and closed notes. You may use a calculator. Answer the questions in the space provided. When answering questions, please state any and all assumptions you are making. For questions involving calculation, indicate your final answer by circling it.

Some formulas you may or may not find useful are:

- Nyquist: Capacity = 2×Bandwidth×log_2(# signaling levels)
- Shannon: Capacity = Bandwidth×$log_2(1 + \frac{S}{N})$
- $log_a X = \frac{lnx}{lna}$
- $E = MC^2$
- Probability(A and B) = Probability(A) × Probability(B) if A and B are independent

Part 1 (12 points)

1. What is the purpose of layering in a data communications architecture like the OSI 7-layer model?

2. A protocol is an agreement in syntax, semantics, and timing. Give *three examples* of situations where prior agreement between communicating systems (or system designers) is required in the protocols and techniques we have discussed. Be specific.

Part 2 (12 points)

1. What is the difference between synchronous and asynchronous communications?

2. Which one (synchronous vs. asynchronous) is better for sending large amounts of data and why?

Part 3 (18 points)

1. What is the principal advantage of the Manchester encoding formats over the the NRZ encoding formats?

2. What is the principal advantage of Differential encoding, as used in NRZ-I and Differential Manchester?

3. Give the Differential Manchester encoding of the following bit sequence: 1 0 1 0 1 1

Part 4 (18 points)

1. A digital signaling system is required to operate at 28800 bits per second. If each signal level encodes 4-bits, what is the minimum required bandwidth. Assume a noiseless channel.

2. We wish to use this 28800 bits per second channel to transmit 8 bit characters. Each character requires 1 start bit, 1 parity bit, and 2 stop bits. If we define the effective data rate as the maximum rate at which *user data* is transmitted, what is the effective data rate of this channel?

3. An analog signal is to be converted into digital form. The analog signal represents frequencies in the range 200Hz to 2000Hz. If the signal is quantized using 8 bits per sample, what is the data rate of the new digital signal?

Question 5: (18 points)

The bit-oriented message 11101111 is to be transmitted from a sender to a receiver.

1. Using an even-parity error detection scheme, calculate the parity bit and show the bitstream that would be transmitted.

2. Instead of parity, we would like to use a CRC-3 for error detection. Show the sender CRC calculation for the message using the generator polynomial $x^3 + x + 1$. Show your work and clearly indicate the final bitstream to be transmitted.

3. A different message was sent between the same two systems and the message 10101100110 was received. Assuming we used the same CRC-3 from above, is this message correct?

Part 6: (25 points)

The following picture depicts the use of the public telephone network to connect two computers at remote locations. In this scenario, a number of conversions occur between analog and digital signaling and data. For each of the five different interfaces, labeled A through E in this picture, give the following information:

1. Describe the data (digital or analog) and the signaling (digital or analog).
2. Name the "device" that performs the function of the interface.
3. Give an example of one encoding technique, (e.g., NRZ-I, Amplitude Modulation) that could be used at this interface.