Data Communications CS420/520
Spring 2006

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Midterm 1

Name: _____ Student ID: _____

This is an *closed* book, *closed* note exam. You may use a calculator but **no computers**. Show **ALL** your work to get full or partial credit for the problem. You have **60** minutes (EO students have **5 extra minutes**).

Show all derivations. Answers (even if they are correct) without derivations are not acceptable and will loose points!!!

Problem	Total	-Points
1	15	
2	10	
3	19	
4	15	
5	15	
6	10	
7	10	
8	6	
Total:	100	

1. (15) Answer the following questions:
   a) Name the seven layers of the ISO/OSI Reference Model, starting with the lowest level.

   b) With respect to the DoD Model: What is the fundamental difference between the TCP and the UDP protocol?

   c) Assume that we have a collection of 28Kbps DTEs we need to multiplex together on a 56Kbps line (K = 1024). Assuming that all of the terminals transmit an average of 23% of the time and the multiplexer compresses data at its inputs to 70% (not by 70%). What is the maximum number of terminals we can reasonably expect to support using statistical time division multiplexing in this situation? Note, you should use the rule of thumb of an 80% utilization.

2. (10 pts) With respect to error correction:

   a) Define the Hamming distance of a code.

   b) What is the Hamming distance of the following code?

      000000 111111 000111 111000

   c) How many errors can be corrected when using the code in part b)?

   d) Now we add the word 010101 to the code of part b). How many errors can now be corrected?

3. (19) With respect to error detection:

   a) Compute the FCS for the message 10110 assuming generator polynomial $G(x) = x^4+x+1$.

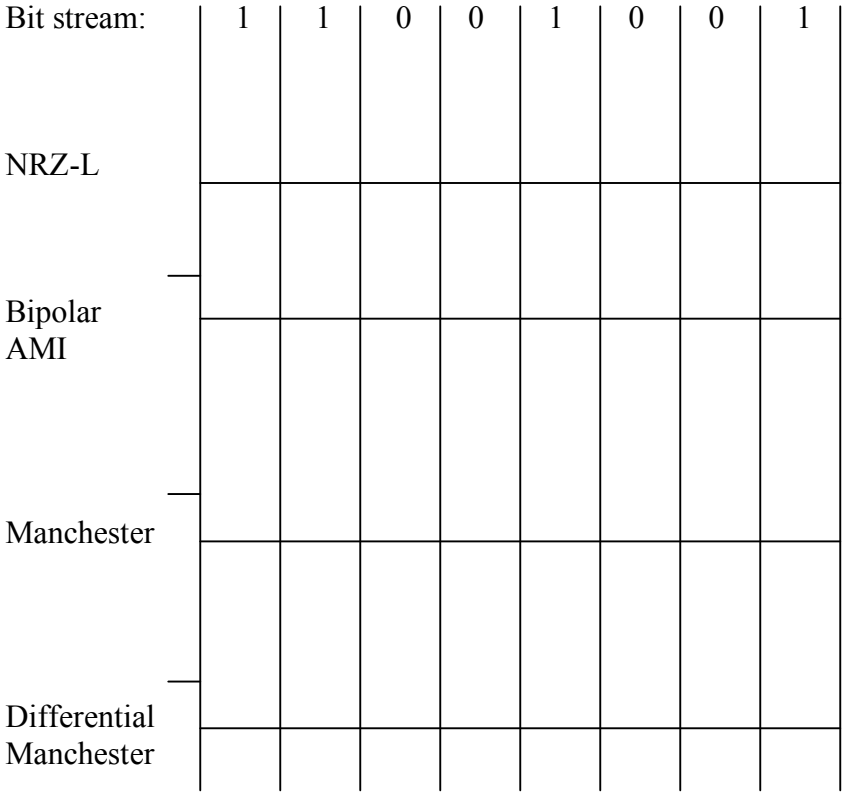
   b) Message 1101010000 (which is unrelated to the message of part a) arrives at the receiver which uses the generator G(x) of part a), i.e. $G(x) = x^4+x+1$. Has there been an error? Justify your answer.

   c) Draw the hardware implementation for $G(x) = x^4+x+1$. Clearly identify the register cells and the mod 2 adders (e.g. XOR).

   d) Given the Generator of the question above, what is the probability of an undetected error?

4. (15 pts) With respect to signal encodings:

a) Encode the following bit stream. Note, that the previous signal levels are indicated when appropriate.



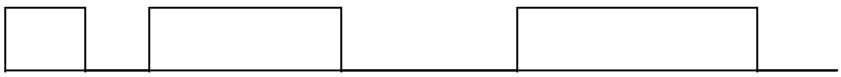
b) In general, what is a possible problem with the Bipolar AMI encoding scheme and name a code that has been used to solve this problem?

5. (15) With respect to modulation:

a) Draw the frequency spectrum for ASK and PSK assuming the carrier and fundamental frequency only.

b) Which scheme, i.e. ASK or PSK, is more efficient with respect to power and why is that?

c) What are the modulated signals for the sample signal below. (You can choose the carrier frequencies, but make sure they are distinguishable).

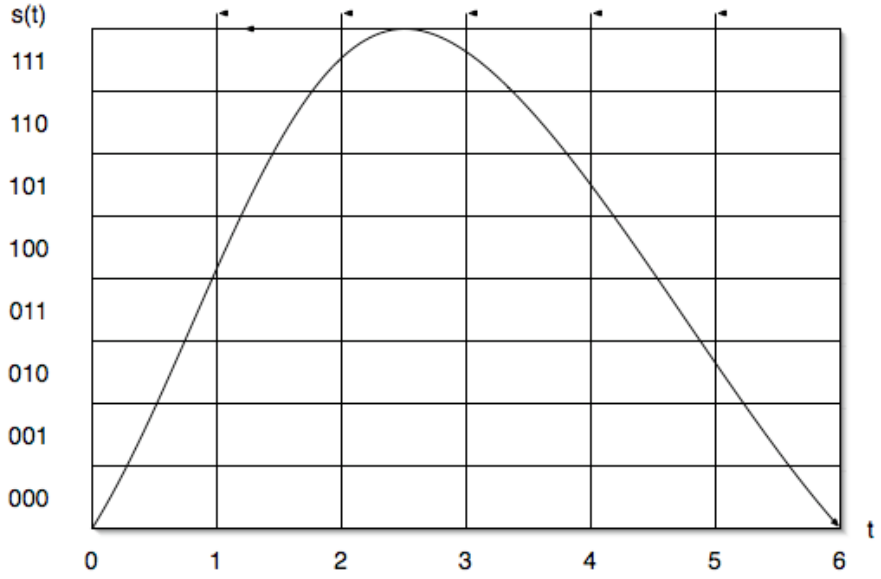
Signal 

ASK _____

FSK _____

6. (10 pts) With respect to analog to digital conversions:

a) Assume the following signal, s(t), is given. Using the figure below, indicate the PAM (Pulse Amplitude Modulation) signal for t = 0 through 6.



b) Next, indicate the PCM signal derived from encoding the PAM

7. (10 pts) We were hired to study the design of a 100kbps modem (k = 1000).
   a) How many signal levels would we need, assuming an available bandwidth of 4000Hz?

   b) If we can use PSK with 8 different phases, how many voltage levels would be required using the result of part a).

8. (6 pts): We are using a 100Mbps link (1M = 10^6) and have a 200m long cable segment. How many bits are in the link as a consequence of a finite propagation delay of a guided communication channel?