

**Data Communications CS420/520**  
**Fall 2000**

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Midterm 1

Last 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 50 minutes.

**Show all derivations. Answers without derivations are not acceptable.**

<b>Problem</b>	<b>Total</b>	<b>-Points</b>
1	15	
2	10	
3	20	
4	15	
5	10	
6	15	
7	10	
8	5	
<b>Total:</b>	100	

1. (15) Circle the correct response(s) for each of the following.
- a) (5 pts) We computed the link utilization for different ARQs. Which of the following results in the largest number of frames sent, assuming some errors will occur?
- i) Idle RQ (Stop and Wait)
  - ii) Go-Back-N
  - iii) Selective Repeat
  - iv) ii) and iii)
  - v) all are the same
- b) (5 pts) 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%). Which of the following is the maximum number of terminals we can reasonably expect to support using statistical time division multiplexing in this situation?
- i) 3
  - ii) 5
  - iii) 9
  - iv) 12
  - v) 15
  - vi) 20
- c) (5 pts) Assume that we use a Huffman encoding of (A = 10, B = 11, C = 01, D = 001) as opposed to a standard ASCII encoding of 7 bits each (NOTE that the above is only a portion of the Huffman tree). The encoded transmission is roughly what fraction of the original for the following message: ABBDCADADADD
- i) 25%
  - ii) 35%
  - iii) 45%
  - iv) 55%
  - v) 65%
  - vi) 75%





- 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.

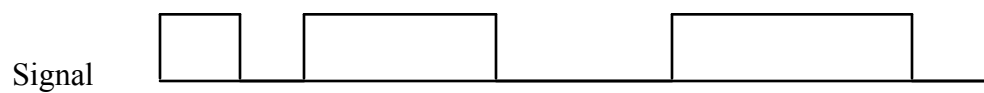
Bit stream:	1	1	1	0	1	0	0	0
NRZ-L								
Bipolar AMI								
Manchester								
Differential Manchester								

- b) Explain two benefits of Manchester over NRZ-L encoding

- c) Explain one benefit of NRZ-L over Manchester encoding

5. (10) With respect to modulation:
- a) (5) Draw the frequency spectrum for ASK and FSK assuming the carrier and fundamental frequency only.

- b) (5) What are the modulated signals for the sample signal below. (You can choose the carrier frequencies, but make sure they are distinguishable).



ASK \_\_\_\_\_

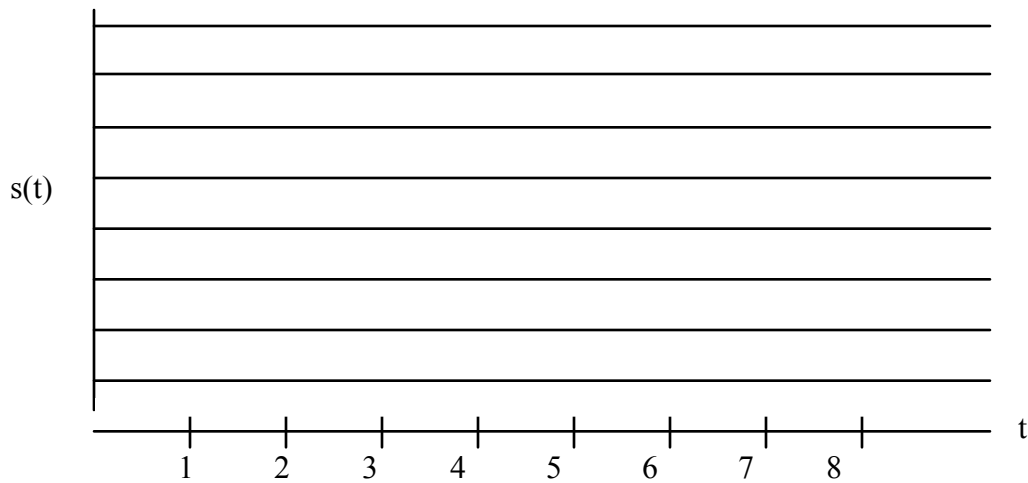
FSK \_\_\_\_\_

6. (15 pts) With respect to analog to digital conversions

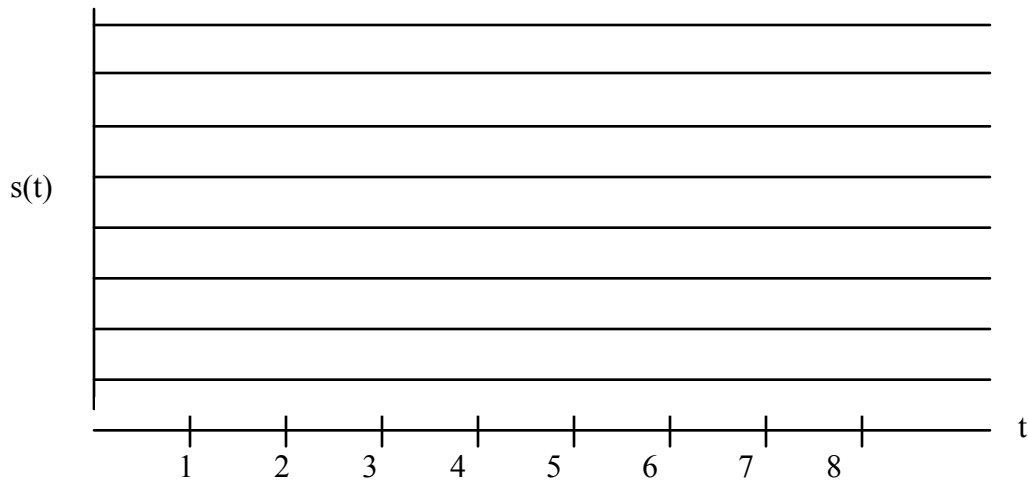
a) (7) Assume we use pulse code modulation (PCM) and we use 3 bits (which lets us differentiate 8 levels). The following bit string has been received at time  $t = 1$ .

000001010011100100011010

Sketch the analog signal that is represented by the string



b) (5) What would the PAM (Pulse Amplitude Modulation) signal look like?





7. (10 pts) We were hired to study the design of a 100Kbps modem ( $K = 1024$ ).
- a) (6) How many signal levels would we need, assuming an available bandwidth of 4000Hz?
  
  
  
  
  
  
  
  
  
  
  - b) (4) If we can use PSK with 4 different phases, how many voltage levels would be required using the result of part a).
8. (5 pts): We are using a 100Mbps link (approximate  $1M = 10^6$ ) and have a 200m long cable segment. How many bits are in the link as a consequence of a finite propagation delay?