Name ______________________

CS4516 D11
Computer Networks
Mid Term Exam
April 4, 2010

Question	Points	Score
0	1	
1	6	
2	4	
3	16	
4	4	
5	4	
6	6	
7	4	
8	3	
9	2	
10	5	
11	3	
12	3	
13	20	
Total	**80**	

Trivia Question (1 extra credit point)

0. (a) What is the capital of Libya?

-OR-

(b) What city is hosting this year's NCAA men's basketball Final Four games?

(3 pts.) 1a. What is a **network protocol**?

(3 pts.) b. Explain the differences between the **OSI Reference Model** and the **TCP/IP Internet** stack.

(2 pts.) 2a. Explain the difference between **channel utilization** and **channel efficiency**.

(2 pts.) b. What is the difference between end-to-end packet **latency** and end-to-end packet **delay**?

(16 pts.) 3. Provide pseudo-code (in Tanenbaum style) for a **one-directional flow** of data from a sending node to a receiving node in a **one-bit sliding window** protocol where the receiver sends an **ACK** when a frame is transmitted correctly and a **NAK** when a frame is received with errors detected.

Sender Receiver

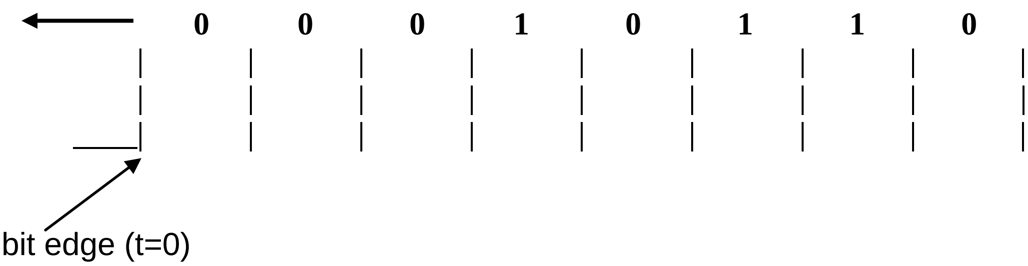
(4 pts.) 4. Explain the **HDLC** scheme for **framing** and **byte stuffing.**

(2 pts.) 5a. Why is **error correction** not normally used at the data link layer?

(2 pts.) b. What is used instead?

(6 pts.) 6. Give the algorithm that the sender uses to prepare and send a frame for transmission that includes a **CRC** field.

(4 pts.) 7. Assume that the voltage level at time t = 0 is **low**, fill in the diagram below to show the **Differential Manchester encoding** for the bit stream 00010110 traveling to the left.



(3 pts.) 8. A **V.34 modem** runs at **2400 baud** to achieve **33,600 bps**. Based on **Nyquist's theorem**, how many **levels** does this modem use to achieve this data rate?

(2 pts.) 9. Explain the difference between **amplitude modulation** and **phase modulation**.

(5 pts.) 10. Draw a diagram and explain how a **T1 carrier** works?

(3 pts.) 11. How does **delta modulation** work and where it would be used?

(3 pts.) 12. Briefly explain the components of the **HFC** architecture.

(20 pts.) 13. Two nodes **A** and **B** are **60 km** apart at opposite ends of a **100 Mbps** optical fiber link. Assume the speed of light is **3×10^8 meters/sec**. Assume node **A** has a **51,231 byte** image stored in memory to send to **B**.

A and **B** share a three-layer 'home brew' network where:

Network layer **packets** have the following format:

Header	Payload	Trailer
36 bytes	4-256 bytes	8 bytes

DATA frames have the following format:

Header	Payload	Trailer
30 bytes	75-1200 bytes	20 bytes

ACK frames have the following format:

Header	Payload	Trailer
30 bytes	75 bytes	20 bytes

Processing time for **A** or **B** to prepare to send any frame is **4 microseconds**.
Processing time for **A** or **B** to receive any frame is **1 microsecond**.

The Data Link layer of the 'home-brew' network uses a simple **STOP-and-WAIT** protocol and for channel efficiency it tries to combine **multiple** packets into a single frame prior to transmission.

How long does it take **A** to successfully send the image to **B** under the best of circumstances (i.e., the channel is error-free)? **(Show ALL calculations to get full or partial credit!)**