CS164 — Fall 2001 Midterm

Aids allowed: calculator.

Name: Student Number:

Problem 1. State whether each of the following statements is **true** or **false**.
(**Two points for each correct answer, −1 point for each incorrect answer.**)

a In a high speed ATM or SONET network, network speeds are described as "OC-3", "OC-12", "OC-48", etc., where the N in "OC-N" says the connection runs 2^N times faster than the basic speed of 1.5 Mbps.

b A process running some layer-N protocol, $N > 1$, doesn't communicate directly with its peer on another host. Instead, it invokes functions provided by the service interface of a layer-$(N-1)$ protocol.

c Ethernet is a type of local area network in which multiple computers are connected to different points along a closed loop of cable.

d A parity code is designed for error *detection*, whereas a polynomial code (also called a CRC) is designed for error *correction*.

e Under code division multiple access, each sender rapidly changes radio frequencies based on a prearranged pseudo-random pattern.

f The primary purpose of a flow control algorithm is to protect the transmitter from overload, by limiting the speed at which the receiver can request more data.

g The 4B/5B code used in Fast Ethernet is basically a *compression scheme* because it converts each group of 5 consecutive bits of user data into a compressed 4-bit "codeword" for transmission over a direct link.

h The Go-Back-N algorithm is used to handle collisions in Ethernet.

i In a token ring, the terms "exhaustive service" and "recirculating service" are two alternate operating modes. In both cases, a special *bypass node* is responsible for removing all packets from the ring: under exhaustive service the bypass node removes all packets after they have completed one trip around the entire ring, whereas under recirculating service the packets remain on the ring until they are claimed by the intended receiver.

j Bit stuffing is an error correction technique, in which the sender inserts three copies of each bit into important messages.

Problem 2. James the secret agent wants to listen in to the messages that Alice is sending to Bob over a direct link. James brings a special Q-brand listening device that is designed to detect NRZ data streams passing through the link. Unfortunately for James, Alice and Bob are using Manchester encoding rather than NRZ, so James must do some extra processing of the bit stream in order to see their messages.

a Suppose Alice and Bob are using a data rate of 10 Mbps over the link. To what data rate should James set his NRZ listening device to capture all the data? Why?

b Briefly explain the algorithm James must use to convert the NRZ data stream that is recorded by his listening device into an actual message that Alice sent to Bob.

Problem 3. Alice wants to send a 1 MByte file to Bob through a private network, using a packet size of 1 KByte. Assume that there is no other traffic in the network, and that we don't need to consider the effect of framing overhead or acknowledgements (i.e., there are no errors and Bob is willing to receive the data as fast as Alice can send it). Also assume that Alice and Bob are connected by a 2-hop path through Carl, and each of those links uses a data rate of 10 Kbit/sec. and has a one-way propogation delay of 10 msec.

a Draw and label a space-time diagram to show how long it takes for Alice's first packet to reach Bob, assuming a 1 msec. processing delay at Carl to allow him to examine the CRC field and select an appropriate output link.

b What is the total time required to transfer the file.

c How much does the total time required change if we: (i) double the packet size to 2 KByte; or (ii) double the data rate to 10 Kbit/sec.; or (iii) reduce the one-way propogation delay by half to 5 msec.

Problem 4. Alice and Bob want to set up a layer 2 connection to exchange frames over a direct link. They agree to: (i) reserve the 5-bit string "01110" to be used as a frame separator and to fill in idle periods; and (ii) to use a CRC code for error checking, using "101" as the generator polynomial. Also, assume that the first message that the application running on Alice wants to send to the application running on Bob over the link is the string "1001110011".

a Briefly explain how *bit stuffing* works, and describe how Alice and Bob would use it to maintain *data transparency* across this link.

b Suppose Alice and Bob decide that the combination of bit stuffing and error checking should be done by first running the application layer message through the "bit stuffing" encoder, and then applying the CRC polynomial algorithm to the "encoded" message to generate the error check field. Show me what the encoded message looks like after "bit stuffing" has been completed.

c Find the CRC that will be appended to the encoded message.

d Will Bob accept the message when it arrives, assuming there are no bit errors along the way? If not, explain what went wrong, and how they can solve the problem.