CS164 Final Exam

Name: Last 4 digits of SSN:

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.**)

1. 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.

2. 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.

3. The acronym "CSMA/CD" stands for "Carrier-Sense Multiple Access with Collision Detection."

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

5. The header of a TCP packet has no source or destination address, because the IP protocol takes care of transporting the packet from the source to the destination.

6. In a token ring, a station may need to start removing the front part of a packet before it has finished transmitting the end of that same packet.

7. Flow control algorithms protect the receiver by limiting the speed at which the transmitter can send data.

8. In IP networks, *subnetting* is used to partition one large network into several smaller ones, by interpretting some of the bits in the host number field as an extension of the network number.

9. The primary function of a subnet mask is to provide security, by hiding the network behind a mask that makes it invisible to the outside world. A firewall is another name for a subnet mask.

10. OSPF is a widely routing protocol that is based on the link state algorithm.

11. Gigabit Ethernet uses an 8B/10B code instead of a 4B/5B code, because it allows data to be sent twice as fast over the same wire.

12. One of the strongest reasons for developing IP Version 6 is to increase the size of an address beyond 32 bits.

13. A Batcher network is a collection of small switching elements connected in a hierarchical pattern that can be used to sort a list of numbers into increasing order.

14. The host interfaces in an ATM network accept data from the host in packets that can be much larger than any Ethernet packet (up to 64K bytes) even though the data is actually tranmitted over the network using cells that are smaller than any Ethernet packet.

15. The Alternating Bit Protocol is a sliding window data link protocol that uses a window size of one frame.

16. The acronym "MSS" stands for the maximum TCP segment size that fits inside a single packet.

17. In a token ring, the terms "early token release" and "multiple token operation" mean the same thing.

18. "Fair" queueing and round-robin scheduling are equivalent if all packets are the same size.

19. The acronym NRZ stands for "non-return to zero" encoding, which means that every "1" data bit maps into the high signal level and every "0" data bit maps ino the low signal level.

20. The acronym NRZI stands for "non-return to zero inverted", which is the same as NRZ except that every "1" data bit maps into the low signal level and every "0" data bit maps ino the high signal level.

Problem 2. State three differences between the ATM Adaptation Layer (AAL) 5 protocol and the older AAL 3/4 protocol that explain why AAL 5 has less transmission overhead than AAL 3/4 even though it is more reliable.
(**9 points**)

Problem 3. In this problem, we consider the Fast Retransmit algorithm in TCP.

1. State three reasons why a TCP receiver might receive packets out of order.
   (**6 points.**)

2. Briefly explain why the TCP receiver must either return a *duplicate acknowledgement* to the sender or do nothing in the event that it receives an out-of-order packet.
   (**4 points.**)

3. Briefly explain the purpose of the Fast Retransmit algorithm and how it works.
   (**5 points.**)

4. One of the code bits in the TCP header is the "ACK" bit, which is used to indicate whether or not the acknowledgement field in this packet is valid. Why must Bob be able to turn the "ACK" bit on and off within different packets if he is also trying to send a stream of data back to Alice at the same time that she is sending data to him.
   (**6 points.**)

Problem 4. Consider the following idealized model to show how the TCP Slow Start algorithm works. Suppose Alice initiates a TCP connection with Bob over a very fast link. Let us assume that the one-way propagation time from Alice to Bob is one second, that Bob can process each incoming packet and generate an acknowledgment (if necessary) in zero time, that each packet contains exactly 1,000 bytes of application data, and that Bob maintains his advertised window at exactly 10,000 bytes at all times.

1. How long will it take until Alice has transmitted the first 10,000 bytes of the file?
   (**6 points.**)

2. How long will it take until the size of Alice's congestion window is at least as large as Bob's advertised window for the first time?
   (**4 points.**)

Problem 5. Consider an Ethernet broadcast domain that includes the following five hosts named "Alice", "Bob", "Carl", "Doug", and "Elvis". Assume that Alice has a 48-bit Ethernet address E_A and a 32-bit IP address I_A, that Bob has Ethernet address E_B and IP address I_B, and so on. Also assume that Doug acts as the name server for this domain and Elvis acts as the router that connects everyone on this domain to the outside world, and that all of the devices in this problem have been manually configured to know that the IP addresses for the name server and router are I_D and I_E, respectively.

1. Briefly explain the ARP protocol, and what type of addresses it is used to find.
   (**3 marks.**)

2. Briefly explain the DNS protocol, and what type of addresses it is used to find.
   (**3 marks.**)

3. Neither the DNS protocol nor ARP runs on top of TCP, even though they both use the IP protocol. Why don't they use TCP also?
   (**2 marks.**)

4. Suppose Alice wants to open a TCP connection to Bob across the Ethernet. Assume that because of a power failure she doesn't remember any information about him besides his name. Outline the steps she must take to gather enough information about Bob to send him the first TCP "open" packet.
   (**5 marks.**)

5. How would these steps change if Alice had wanted to connect with some host outside this domain?
   (**3 marks.**)

6. If the network contained a shared hub (or repeater) in the middle, then every packet that was sent to or from Alice would also reach Carl. However, suppose we replace the shared hub by an Ethernet switch (i.e., a layer 2 transparent bridge), so that each of our five hosts is connected to a different switch port. Which of the packets (if any) that were part of Alice's connection setup with Bob would reach Carl now?
   (**4 marks.**)