CSC 4220/6220 – Exam #1 Fall 2016 Name:_____

- **Closed book / Cheat sheet allowed**
- **State any assumptions**
- **Show all work / Justify all answers**
- **Turn off cell phones**

In accordance with both the letter and spirit of the University Policy on Academic Honesty, I have neither given nor received assistance on this examination.

SIGNATURE: _____

1. Consider two hosts, A and B that are connected by a fiber optic transmission link of 6 Mbps with propagation speed of $12x10^8$ m/s. Packet length is 1.5 Kb (Kilobits) and link length is 300Km.
    a. What is the *propagation delay* from A to B - the amount of time from when the first bit of the packet is transmitted at A, until it is received at B?

    b. What is the *transmission time* of the packet at A (the time from when the first bit of the packet is sent into the wire, and the time at which the last bit is sent into the wire)?

    c. How long must a packet be so that the receiver is receiving the first bit at the same time that the sender is sending the last bit?

2. Assume you have a base html file with 12 embedded images that is requested by a client. Assume that the base file and all of the images are small enough to fit within one TCP segment. How many round trips are required to retrieve the base file and the images under the following settings?

    a. Non-persistent HTTP 1.0 with up to 8 parallel connections

    b. Persistent HTTP 1.1 with no pipelining

3. Give the 4-bit checksum of the following message:
   0010000011001111110

4. Consider a circular DHT with node and key identifiers in the range [0,63]. (Node IDs are given in decimal and key values in binary). Suppose there are nine peers with identifiers 6, 11, 13, 20, 37, 40, 43, 47 and 56. Suppose each peer has a shortcut to nodes that are distance 4 away in the overlay network.

a. Which peers are responsible for keys 000010 and 100110

b. Describe the series of query messages if node 6 is trying to determine which peer is responsible for key value 110010.

c. Describe the series of steps to recover if node 20 discovers that node 37 has left the network.

5. Consider a scenario where a web server is connected to router R1 by a 400 Mbps link, with 300 ms propagation delay. R1 is connected to another router, R2, over a 50 Mbps link with 150 ms propagation delay. A 2 Gbps link connects a LAN with multiple hosts with negligible propagation delay. All packets in the network are 20Kbits.

a. What is the end-to-end delay from when a packet is transmitted by the server to when it is received by a host? Neglect any queuing and nodal processing delays.

b. Assume a cache is added to the LAN and that its hit rate is 40%. What is the average rate of requests being satisfied?

6. Circuit switching vs packet switching

a. Calculate how long it takes to send a 1Mb file over a 3Mbps link with a circuit switched network that uses 24 different frequency slots and requires a 600ms connection set up time.

b. Assume you now have a 10 hop packet switched network, where each link is 3Mbps, and all packets are 1Kb. Neglect nodal processing, queueing and propagation delays.

7. Consider a P2P network where an origin server hosts a file of 10 Gbits to distribute to 100 peers. Assume the server has an upload rate of 50Mbps, and all peers have equal connections, where the download rate is 2Mbps and the upload rate is 400 Kbps. What is the lower bound of time required to distribute this file to all the peers?

8. Short answer questions

a. Assume the application layer generates a message of size 2000 Kbits and that the segment size for the transport layer is 2000 bits. Would the message be broken into 2000 packets? Or would more or less be needed?

b. Can a client process open multiple TCP connections to the same server process? If so, how would the multiplexing and demultiplexing work properly?

c. We saw the the FTP protocol uses out of band connections, in that the control and data are over separate TCP connections. Is it possible for an application to communicate out of band, where one band is TCP and the other UDP? If so, how would this be implemented? If not, explain why not.

d. Imagine looking at the traffic intensity over time at a particular router in the network. Initially, the intensity averages 0.5, then after a period of time rises to 0.91 on average, then rises again to 1.39 and finally settles down around 0.27. Briefly explain what you would experience over these 4 phases of time.