Data Communication & Networks

Summer 2008 Semester

Roll Number _____

Name _____

Section _____ Signature: _____

FINAL

Wednesday, 30th July 2008

_____

Signature of Invigilator

Total Time: 120 Minutes
Total Marks: 80

Course Instructors:
Engr. Waleed Ejaz

Q	3	4	5	6	7	8	9	Total
Marks	15	15	8	10	16	6	10	80
Obtained Marks								

You are advised to READ these notes:

1. **Attempt the paper on the question paper. NO EXTRA SHEETS will be provided. Use the back of the page if more space is required. However, no extra sheet will be checked.**
2. After asked to commence the exam, please verify that you have **fourteen (14) different printed pages** including this title page.
3. There are **7 questions (Q3-Q9)**. Attempt all of them. It is advisable to go through the paper once before starting with the first question.
4. All questions don't carry **equal marks**. Marks for subparts are indicated.
5. If part of a problem depends on a previous part that you are unable to solve, explain the method for doing the current part, and, if possible, give the answer in terms of the quantities of the previous part that you are unable to obtain.
6. Exam is closed books, closed notes. Please see that the area in your threshold is clean. You will be charged for any material which can be classified as 'helping in the paper' found near you.
7. Calculator sharing is strictly prohibited.
8. Students who attempt the paper with **lead pencils** loose the right to get them rechecked.

9. The invigilator present is not supposed to answer any questions. No one may come to your room for corrections and you are not supposed to request to call anyone. Make assumptions wherever required and clearly mark them.

Question 3
[6+2+7]

a. Consider sending a packet of F bits over a path of Q links. Each link transmits at R bps. The network is lightly loaded so that there are no queuing delays. Propagation delay is negligible.

i. Suppose the network is a packet switched virtual circuit network Denote the VC setup time by t_s Seconds. Suppose the sending layers add a total of h bits of header to the packet. How long does it take to send the file from source to destination? [2 Mark(s)]

ii. Suppose the network is a packet switched datagram network and a connectionless service is used. Now suppose each packet has 2h bits of header. How long does it take to send the packet? [2 Mark(s)]

iii. Finally, suppose the network is a circuit switched network. Further suppose that the transmission rate of the circuit between source and destination is R bps. Assuming t_s setup time and h bits of header appended to the packet, how long does it take to send the packet? [2 Mark(s)]

b. Which of the following cable technologies may be used to support a 100 Mbps Ethernet Local Area Network?

i. Coaxial cable
ii. Fibre optic cable
iii. Unshielded twisted pair cable[2 Mark(s)]

c. Consider the following network shown in figure below:

i. If W sends an IP packet to X which systems receive this packet at their physical interface and what action they do with it? [3 Mark(s)]

ii. If X sends an IP packet to Y, which system's Medium Access Control (MAC) address will be inserted in the source address field of the packet which is received by Y. [2 Mark(s)]

iii. If V sends an IP broadcast packet, which End Systems will receive it? [2 Mark(s)]

Question 4

[4+4+3+2+2]

a. Determine the data sequence for the following waveform assuming:

i. Manchester encoding [2 Mark(s)]

ii. Differential Manchester encoding [2 Mark(s)]

b. A modem has a baud rate of 2400 symbols/sec. What would be the bit rate for this modem if its phase-amplitude constellation is as follows? [4 Mark(s)]

c. A voice grade modem has a maximum data rate of 19,200 bps. What would be the maximum data rate of that modem if the number of points in its constellation were doubled? [3 Mark(s)]

d. Draw the synchronous TDM frames showing the character data given four signal sources sending the following data :

Source 1 message: T E G

Source 2 message: A

Source 3 message:

Source 4 message: E F I L

Assume that the character on the right (i.e., G for source 1) is sent first. [2 Mark(s)]

Synchonous TDM

e. Redo part (d) assuming that statistical TDM is being used with a frame size of three characters. [2 Mark(s)]

Statistical TDM

Question 5

[2+6]

a. Given a 2400 BPS terminal that transmits ASCII characters using asynchronous transmission (one start and 1 stop bit). What would the minimum time be to send a 200 character message? [2 Mark(s)]

b. What would be the minimum time for a synchronous terminal (2 sync, 4 control, and 2 CRC characters per block) to transmit the same message, if each block contained a maximum of

i. 20 [2 Mark(s)]
ii. 100 [2 Mark(s)]
iii. 1000 [2 Mark(s)]

data characters plus the sync/control/CRC characters?

Question 6

[4+4+1+1]

a. An application has the following bit pattern to transmit over a Stop and Wait communications link:

1 0 0 1 0 0 1 1 0 1 1 0

What would be the data bits sent over the communication channel if the data link used a cyclic redundancy check with a generator polynomial of the form:

$P(x) = x3 + 1$ [4 Mark(s)]

b. If the bits that arrived at the receiver for the above transmission had the following bit pattern:

1 0 0 1 0 0 1 1 0 1 1 1 0 0 1

What would be the response of the receiver? [4 Mark(s)]

c. Assume a Sliding Window with Go-Back N ARQ is being used on a transmission link with a window size of 7 (window includes frames numbers 0 through 6). The transmitter

has previously sent frames 0, 1 and 2. Is the transmitter allowed to send frame 3 if frame 2 has not been acknowledged? Explain your answer. [1 Mark(s)]

d. Assume a Sliding Window with Selective-Reject ARQ is being used on a transmission link with a window size of 8 (transmit and receive window includes frames numbers 0 through 7). Host A sends frames 0, 1, 2, 3, and 4 to the receiver and frame 3 is received in error by Host B. What would be the frame number in the ACK sent back by Host B? [1 Mark(s)]

Question 7
[4+3+9]

a. When an *Internet Protocol (IP)* packet is carried in a link layer frame, it contains addresses at both the link layer and network layer.

i. How does the node identify its own hardware address? [1 Mark(s)]

ii. How does the node identify the hardware address of the intended recipient? [1 Mark(s)]

iii. How does the node identify its own IP address? [1 Mark(s)]

iv. What protocol is used to find out the IP address of the intended destination end system, when only the name of the system is known? [1 Mark(s)]

b. Consider the network shown in the figure below. The links are labeled with relative costs.

Give the datagram routing table at router S2, assuming least-cost paths are used. Your table should consist of one row for each possible destination host (including the default destination, OUT) consisting of the destination ID, output port, and distance. [3 Mark(s)]

c.

The figure above shows IPv4 datagram. The diagram below illustrates Router **R1** sending a datagram to host H through Router **R2**.

Link **L1** only permits a MTU of 1500 bytes. Link **L2** only permits a MTU of 1100 bytes. (MTU= Maximum Transfer Unit).

A is an IP datagram which

- Has size 4000 bytes (the size of a datagram includes its header)
- Is not using any of the option fields in its header.

Because **A** is larger than the MTUs of Links **L1** and **L2**. A must be fragmented as it is sent from **R1** to **H**. Assume that all datagram's sent are received successfully.

i. Into how many IP datagrams is **A** fragmented when it is sent from **R1** to **R2** over **L1**?
What is the size (in bytes) of each of these smaller fragments?
Which of these fragments has its offset-flag bit set to 0?

ii. In order for Host **H** to receive the data in **A**, **R2** must also send some datagrams to **H**.

How many IP datagrams does **H** receives?

What is the size (in bytes) of each of these smaller fragments?

Which of these fragments has its offset-flag bit set to 0?

Question 8

[3+3]

a. TCP opens a connection using an initial sequence number (ISN) of 14,137. The other part opens the connection with an ISN of 18,332. Show the three TCP segments during the connection establishment. [3 Mark(s)]

b. A client uses TCP to send data to as server. The data are 16 bytes. Calculate the efficiency of this transmission at the TCP level(ratio of the useful bytes to total bytes). Calculate the efficiency of transmission at the IP level. Assume no options for the IP header. Calculate the efficiency of transmission at the datalink layer. Assume no options for the IP header and use Ethernet as the datalink layer. [3 Mark(s)]

Question 9

[6 + 4]

a. Suppose that the top-level domain (TLD) server for the .edu domain contains the following two records:

(umass.edu, dns.umass.edu, NS)
(dns.umass.edu, 128.119.40.200, A)

Also suppose that machine dns.umass.edu has the following source record:

(gaia.cs.umass.edu, 128.119.40.200, A)

Now suppose that you are working at FAST and your local machine needs to resolve the name gaia.cs.umass.edu. The first step is for your local host to pass the request the name gaia.cs.umass.edu. Your local name server then performs a sequence of queries and, after completion, sends your local host the resolved IP address. Describe the sequence of queries between your local name server and the other servers involved in the query process. List all of the servers involved and who talks with whom. What is the number of communications needed to obtain the IP address of gaia.cs.umass.edu?

You should assume that there are no IP addresses cached at any of the intermediate servers. The only records kept at intermediate servers are those that are required to be kept there. You should also assume that the processing of all queries is iterative (i.e., not recursive). [6 Mark(s)]

b. Suppose within your Web browser you click on a link to obtain a Web page. Suppose the IP address for the associated URL is not known and its IP address has to be searched with the DNS (Domain Name Server) protocol. Suppose that n DNS servers are visited before your host receives the IP address and that the successive visits incur a round-trip time of RTT1, RTT2,….. RTTn. The round-trip time (RTT), which is the time it takes for a small packet to travel from client to server and then back to the client. The RTT includes packet-propagation delays, packet-queuing delays in intermediate routers and switches, and packet-processing delays. Further suppose that the web page associated with the link contains exactly one object, a small amount of HTML text. Let RTT0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object? [4 Mark(s)]