Data Communication & Networks

Fall 2008 Semester

Roll Number ______________________

Name ____________________________

Section ______ Signature: __________

MID II

Tuesday, 21st October 2008

Total Time: 60 Minutes
Total Marks: 45

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Signature of Invigilator

Course Instructors: Engr. Waleed Ejaz

Q	1	2	3	4	5	Total
Marks	8	6	8	12	11	45
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 **nine (9) different printed pages** including this title page.
3. There are **5 questions**. 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. **Suggested time** for each question is also indicated but this is not hard and fats, its just for your convenience,
6. 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.
7. 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.
8. Calculator sharing is strictly prohibited.
9. Students who attempt the paper with **lead pencils** loose the right to get them rechecked.

10. 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 1

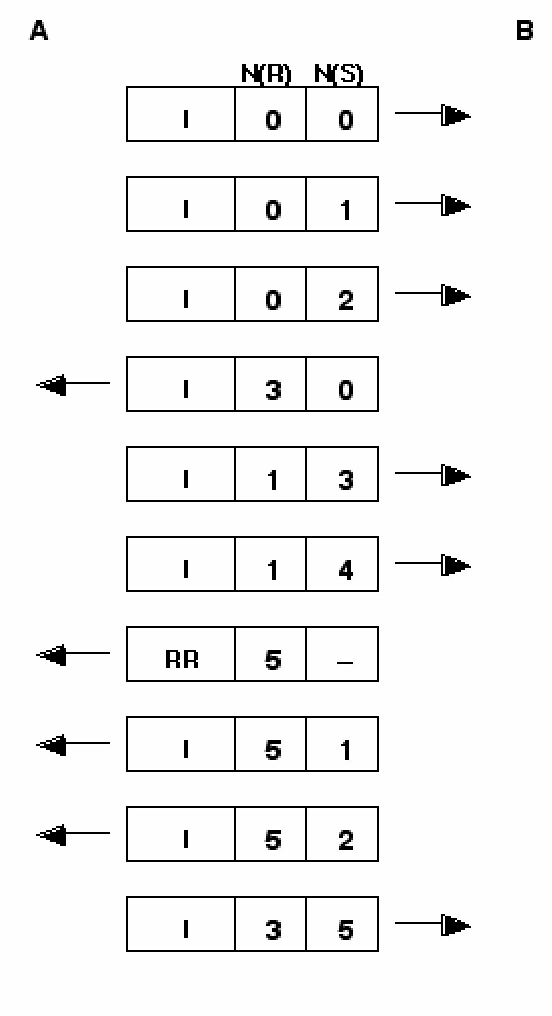
(5+3)

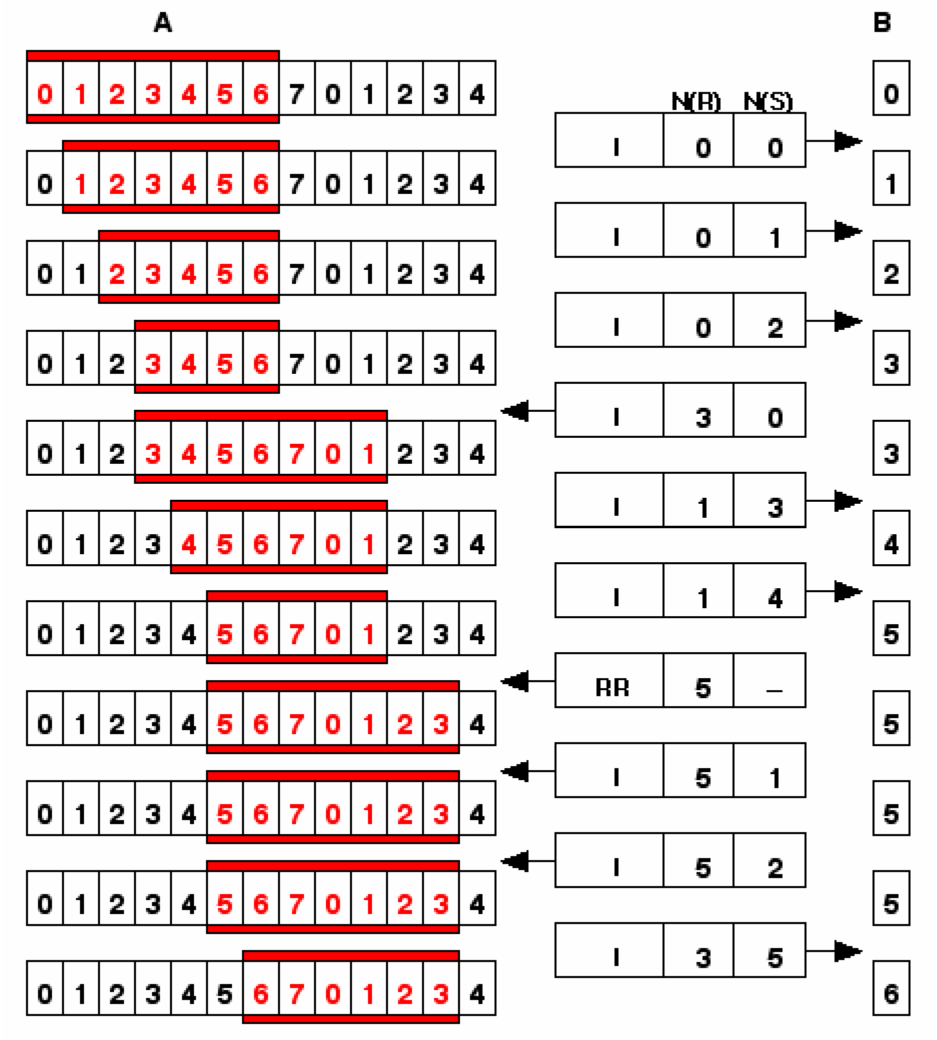
a. The frame transfer sequence for a full duplex data link protocol that uses go back N error control is shown below.

i. What are the values for the send sequence number, N(S), and the receive sequence number, N(R), for each of the frames sent?

ii. What is the send window for node A and the receive window for node B for each step?

Assume a 3 bit sequence number with the maximum send window size and that the sequence number N(S) is initialized to 0.



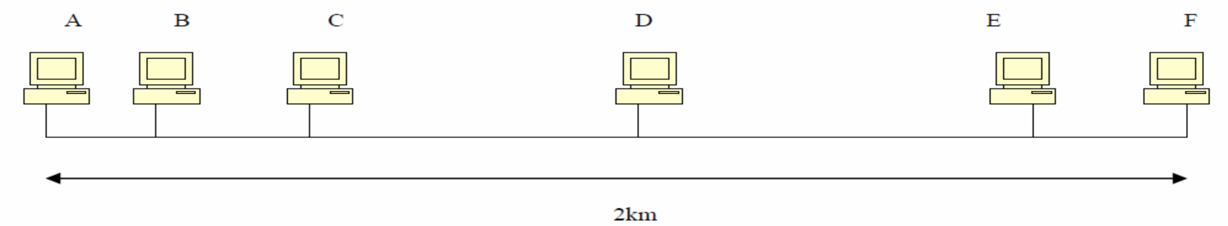


b. A transport connection sends 5 packets, but the remote receiver only receives the following packets: D(0), D(1), D(3) and D(4). Draw a transition diagram to show how the receiver may recover the missing packet using Go-Back-N ARQ. Your diagram should show all packets (with sequence numbers) which form a part of the transmission

Question 2

(3+3)

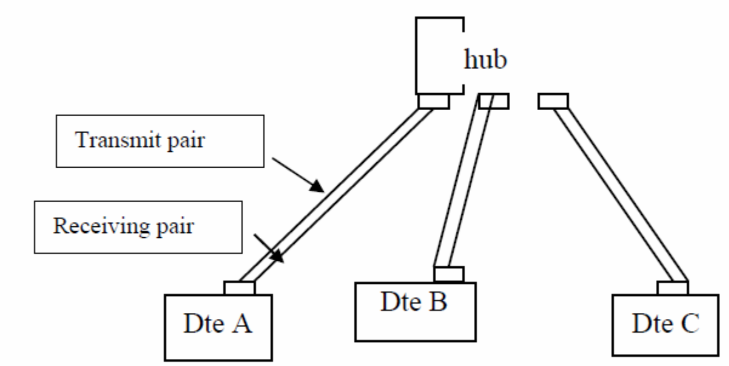
a. Consider the following linear network that is 2km long.



Assume that propagation speed of electromagnetic waves sent over the medium is $2*10^8$ m/s and the transmission rate of the network is 10Mbps. What is the minimum frame size (in bits) necessary to ensure that CSMA/CD will work properly for this network? Explain your reasoning.

Solution:
In order for CSMA/CD to work a transmitting host must know about a collision (by hearing it on the link) BEFORE the transmitting host completes its transmission.
Let d = distance between hosts X and Y.
Let R = $2*10^8$ m/s be the propagation speed of the network
Suppose host X starts transmitting a frame of size F.
Then, before hearing the first bit of the frame, host Y starts transmitting a frame. This can be at most d/R time after X starts transmitting and X hears the beginning of Y's transmission d/R time after that. Therefore, the MAXIMUM amount of time that can pass from the time that X starts transmitting until X hears the first bit from Y is 2d/R.
Therefore we must have F/10Mbps >= 2d/R. d can be 2 X10^3 m (if X and Y are A and F) so F has to be at least F = 2dR/10^3 = 200 bits.

b. In the following CSMA/CD 10BaseT network calculate the worst case time needed by the transmitting station A to learn about the collision caused by the transmission at the station C. Assume that length of each twisted pair is 50m and that one way propagation delay through hub is 0.1µs . Also assume that signal propagation speed in the twisted pair is 2 x 10^8 m/s.

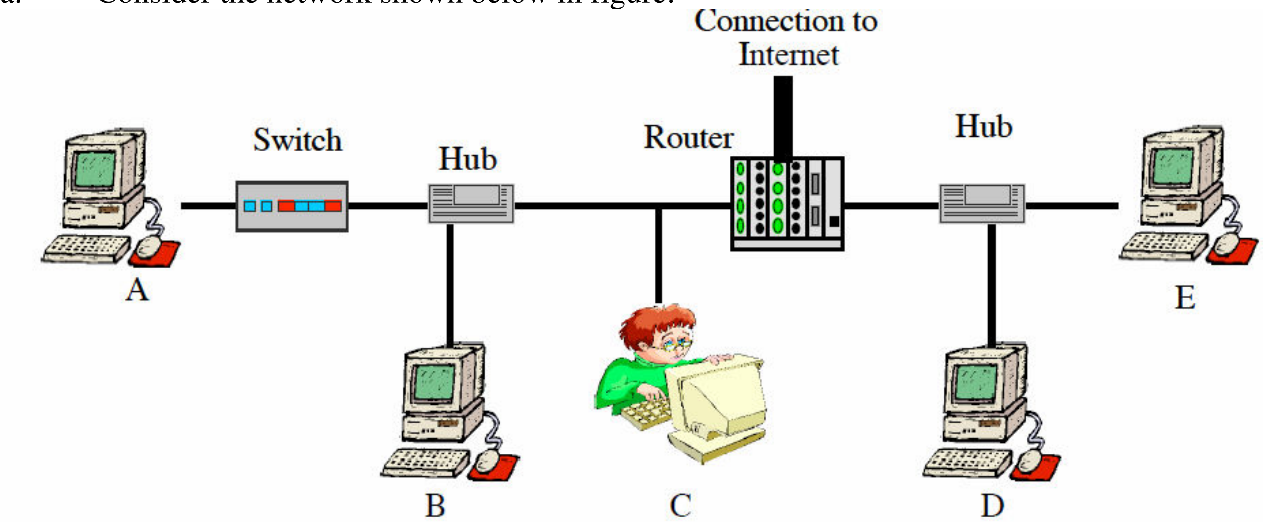


Solution: Worst case time to learn about the collision is 4 x 0.25 µs + 2 x 0.1 µs = 1.2 µs.

Question 3

(4+4)

a. Consider the network shown below in figure:



i. Provide a diagram of this network clearly labeling each Collision Domain

Domain 1: A - Switch Port for A

Domain 2: Switch Port for Hub I; B;Hub I;C; Router Port to C

Domain 3: Router Port for Hub II; B;Hub II ;D; E

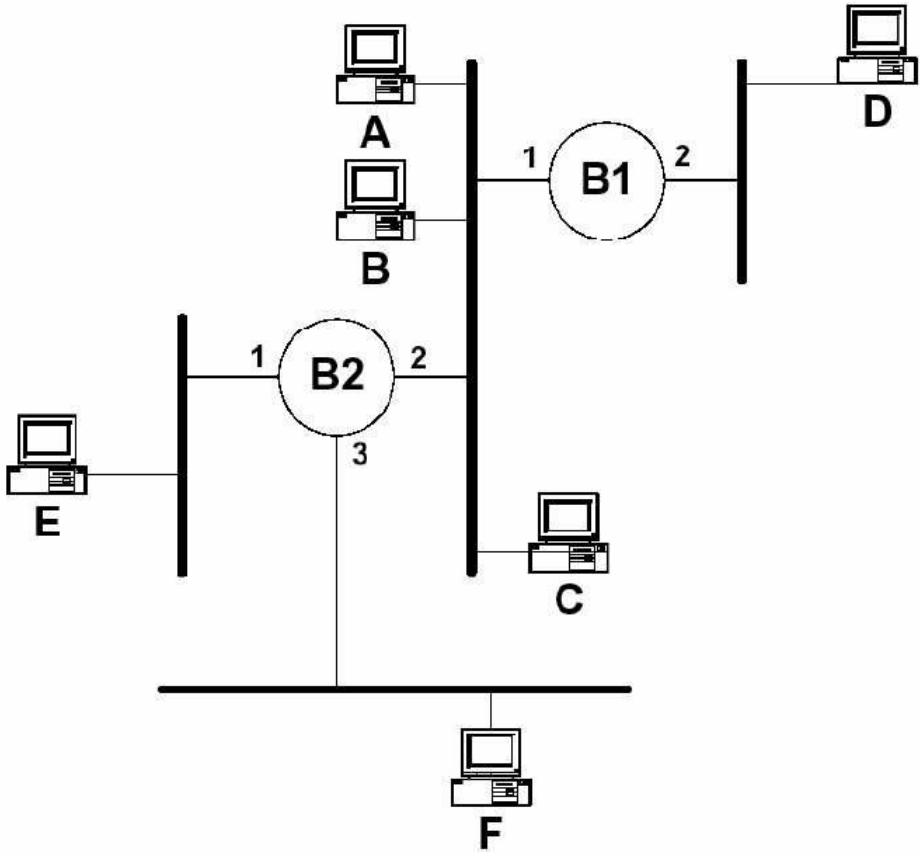
Domain 4: Router Port for Internet Feed

ii. Given there are two IP networks, list the End Systems present in each IP network.

IP 1: A,B,C

IP 2: D,E

c. Consider the network of learning bridges (switches) shown in the following figure:



Show the forwarding table in each of the bridges after the following transmissions (which occur in the given order), assuming each table starts out empty:

i C sends to A
ii F sends to E
iii E sends to F
iv D sends to B

Give a table for each bridge, each with two columns: destination and port number, showing how the bridge would forward traffic.

B2		B1	
C	2	C	1
F	3	F	1
E	1	D	2
D	2		

Question 4
(1+1+1+1+3+5)

a. Briefly describe the role of beacon frames in 802.11.

Beacon Frames transmitted in each of the 11 channels help a wireless station to identify nearby APs.

b. Why are acknowledgments used in 802.11 but not in wired Ethernet?

In wireless channels bit error rates are high and collision detection can not be effectively done.

c. What is the purpose of the NAV in 802.11?

Network Allocation Vector (NAV) forces other stations to defer sending their data if one station acquires access. In other words, it provides the collision avoidance aspect.
When a station sends an RTS frame, it includes the duration of time that it needs to occupy the channel. The stations that are affected by this transmission create a timer called a NAV.

d. What is the IEEE standard that defines the CSMA/CD (Ethernet)?

802.3

e. Suppose you purchase a wireless router and connect it to your cable modem. Also suppose that your ISP dynamically assigns your connected device (that is, your wireless router) one IP address. Also suppose that you have five PCs at home that use 802.11 to wirelessly connect to your wireless router.

i How are the IP addresses assigned to the five PCs?
ii What does the wireless router use for it?

IP addresses are assigned from the range of private addresses.
Wireless router uses NAT for it.

f. After being hired as Network Manager at FAST-NU, you are tasked by your supervisor with assigning IP addresses for your new MAN (Metropolitan Area Network), which consists of 8 different buildings; each building will have 255 workstations. Your supervisor tells you to only use as much of the 164.10.0.0 network as you needed. Your supervisor will assign the IP addresses to the serial interfaces using a different network. You will need to determine the following four items for each of the eight buildings:

i Subnet Masks
ii Network Addresses
iii Broadcast address for each subnet
iv Valid host ranges on each subnet

A) 255.255.254.0

B) 164.10.2.0
164.10.4.0
164.10.6.0
164.10.8.0
164.10.10.0
164.10.12.0
164.10.14.0
164.10.16.0

C) 164.10.3.255
164.10.5.255
164.10.7.255
164.10.9.255
164.10.11.255
164.10.13.255
164.10.15.255
164.10.17.255

D) 164.10.2.1 - 164.10.3.254
164.10.4.1 - 164.10.5.254
164.10.6.1 - 164.10.7.254
164.10.8.1 - 164.10.9.254
164.10.10.1 - 164.10.11.254
164.10.12.1 - 164.10.13.254
164.10.14.1 - 164.10.15.254
164.10.16.1 - 164.10.17.254

Question 5
(2+4+1+4)

a. Consider a host A sends IP packets to a host B, and they are separated by a number of different IP networks. Assume that IP option fields are absent. Suppose we know that the path MTU for A to send packets to B is given by P bytes. If host A sends an IP datagram of size D bytes to host B, no fragmentation occurs if $P \geq D$.

i If $P < D$, what is the minimum number of IP fragments as a result of IP fragmentation, in terms of P and D?

The minimum number of fragments = $\lceil (D - 20)/(P - 20) \rceil$. The amount of data to be fragmented into multiple IP packets is given by D – the IP header's size = D – 20. Similarly, each fragment can accommodate at most P – the IP header's size = P – 20.

b. Suppose the fragments shown below all pass through another router onto a link with an MTU of 380 bytes, not counting the link header. Show the fragments produced.

more fragment **bit**	**Offset**	**Number of Data bytes carried**
1	0	396
0	47	156
1	0	396

0	47	156
1	0	396

c. If the packet were originally fragmented for this MTU (380 bytes), how many fragments would be produced?

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d. Assume that network address of the home network consisting of 3 PC's is 192.168/16. Assume also that this network is connected to an ISP router with address 126.13.89.67 via a NAT router.

i Assign addresses to all interfaces in the home network.

ii Suppose each host has two ongoing TCP connections, all to port 80 at host 128.119.40.86. Provide the six corresponding entries in the NAT translation table.

a. Home addresses: 192.168.0.1, 192.168.0.2, 192.168.0.3 with the router interface being 192.168.0.4

b.

NAT translation table	
WAN side	LAN Side
128.119.40.86, 4000	192.168.0.1, 3345
128.119.40.86, 4001	192.168.0.1, 3346
128.119.40.86, 4002	192.168.0.2, 3445
128.119.40.86, 4003	192.168.0.2, 3446
128.119.40.86, 4004	192.168.0.3, 3545
128.119.40.86, 4005	192.168.0.3, 3546