City University of Hong Kong
Department of Electrical Engineering

EE3009 Data Communications & Networking
Test 2

25 November 2020
Time: 1 Hour and 15 minutes
(inclusive of 15 minutes for uploading)

Instructions :

Please hand-write all answers on blank answer sheets, compile the answers into a single PDF file, and **upload the file before the deadline** of the test.

Answering this test paper implies your acknowledgment of the Pledge for following the Rules on Academic Honesty:

"I pledge that the answers in this test are my own and that I will not seek or obtain an unfair advantage in producing these answers. Specifically,

1. I will not plagiarize (copy without citation) from any source;
2. I will not communicate or attempt to communicate with any other person during the test; neither will I give or attempt to give assistance to another student taking the test; and
3. I will use only approved devices (e.g., calculators) and/or approved device models.
4. I understand that any act of academic dishonesty can lead to disciplinary action."

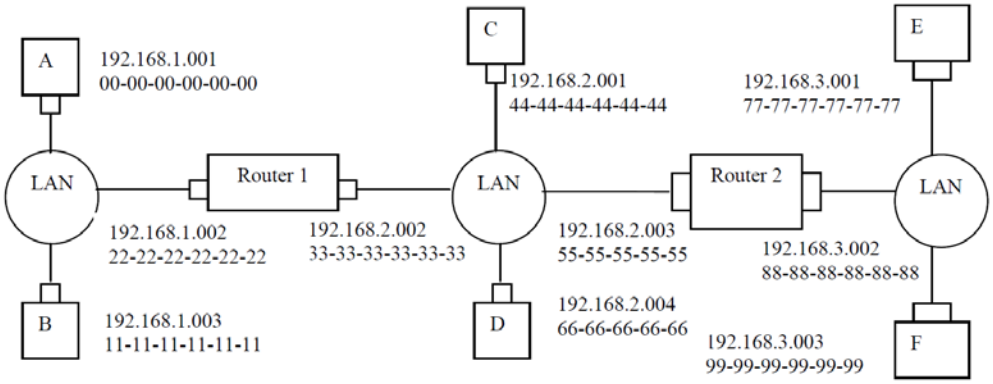
On the first page of your answer sheets, copy the following sentence and sign it:

I pledge to follow the Rules on Academic Honesty and understand that violations may lead to severe penalties.

*(*Signature) _____ (Date) _____

1) 10 pts
Forwarding table in E determines that the datagram should be routed to interface 192.168.3.002.
The adapter in E creates and Ethernet packet with Ethernet destination address 88-88-88-88-88-88.
Router 2 receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 198.162.2.002.
Router 2 then sends the Ethernet packet with the destination address of 33-33-33-33-33-33 and source address of 55-55-55-55-55-55 via its interface with IP address of 198.162.2.003.
The process continues until the packet has reached Host B.

1. Figure 1 shows three LANs interconnected by two routers. The IP address and MAC address of each interface are as given. Suppose that the ARP table in Host F is empty and all other ARP tables are up to date. The forwarding tables of both routers are also up to date. Consider that an IP datagram is sent from Host F to Host A, enumerate all the steps involved in forwarding this IP datagram from the source to the destination.



[10 marks]

2. Six nodes labelled A through F are star connected into an Ethernet switch. The switch table is initially empty. The following events happen in sequence: (i) B sends a frame to E, (ii) A sends a frame to B, (iii) B replies a frame to A. Complete the following table.

3. Event	Changes to the switch table	Link(s) packet is forwarded to	Explanation
B sends a frame to E			
A sends a frame to B			
B replies a frame to A			

[6 marks]

3. A group of *N* stations share a 56-kbps pure ALOHA channel. Each station generates a 1000-bit frame on an average of once every 100 seconds. What is the maximum value of *N*?

[2 marks]

4. Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer.

[2 marks]

5. Consider two nodes, A and B, that use the slotted ALOHA protocol to contend for a channel. The probabilities that A and B send a packet in a slot are p_A and p_B, respectively.
   a. Give an expression for node A's average throughput.
   [2 marks]
   b. What is the total efficiency of the protocol with these two nodes?
   [2 marks]
   c. What is the relationship between p_A and p_B if node A's average throughput is three times as large as that of node B?
   [2 marks]

6 When a HDLC frame is transmitted, is it possible for the loss of a single bit to cause an error not detected by the frame check sequence (FCS)? If not, why not? If so, how?
[5 marks]

7 If the bit string 0111101111101111110 is to be bit stuffed, what is the output string?
[1 mark]

8 a. Give the codeword for the data bit sequence 0101100 encoded by the Single Parity Code. [1 mark]
b. Assume that the codeword is transmitted through a channel with bit error rate *p*, write down an expression of the probability that two bits are corrupted.
[2 marks]

9 The generator polynomial $x^3 + 1$ is used to perform the CRC function.
   a. Draw the shift register circuit that would perform this task.
   [2 marks]
   b. The receiver has received a codeword 10100001000. Determine if there is any error in the received codeword.
   [5 marks]

10 The header of a packet has six 16-bit words, corresponding to the binary representation of the numbers 1 through 6. Compute the 16-bit internet check sum of this header.
[2 marks]

11 What are the advantages of CHAP over PAP?
[2 marks]

12 Two personal computers are connected by a 64 kb/s link and the one way propagation delay is 100 ms. The bit error rate of the link is 10^{-4}. Each frame contains 512 bytes, among which 4 bytes are overhead. Find the efficiency of Selective Repeat ARQ.
[4 marks]

13 Consider a star-topology network in which 25 terminals are attached by a dedicated pair of lines to a hub in a star topology. The distance from each terminal to the hub is 2500 meters, the speed of the transmission lines is 10 Mbps, all frames are of length 12,500 bytes, and the signal propagation on the line at a speed of $2.5x10^8$ meters/second. The token ring protocol is used for medium access control. Assume single-frame operation and eight-bit latency at each station. Find the maximum throughput.

[4 marks]

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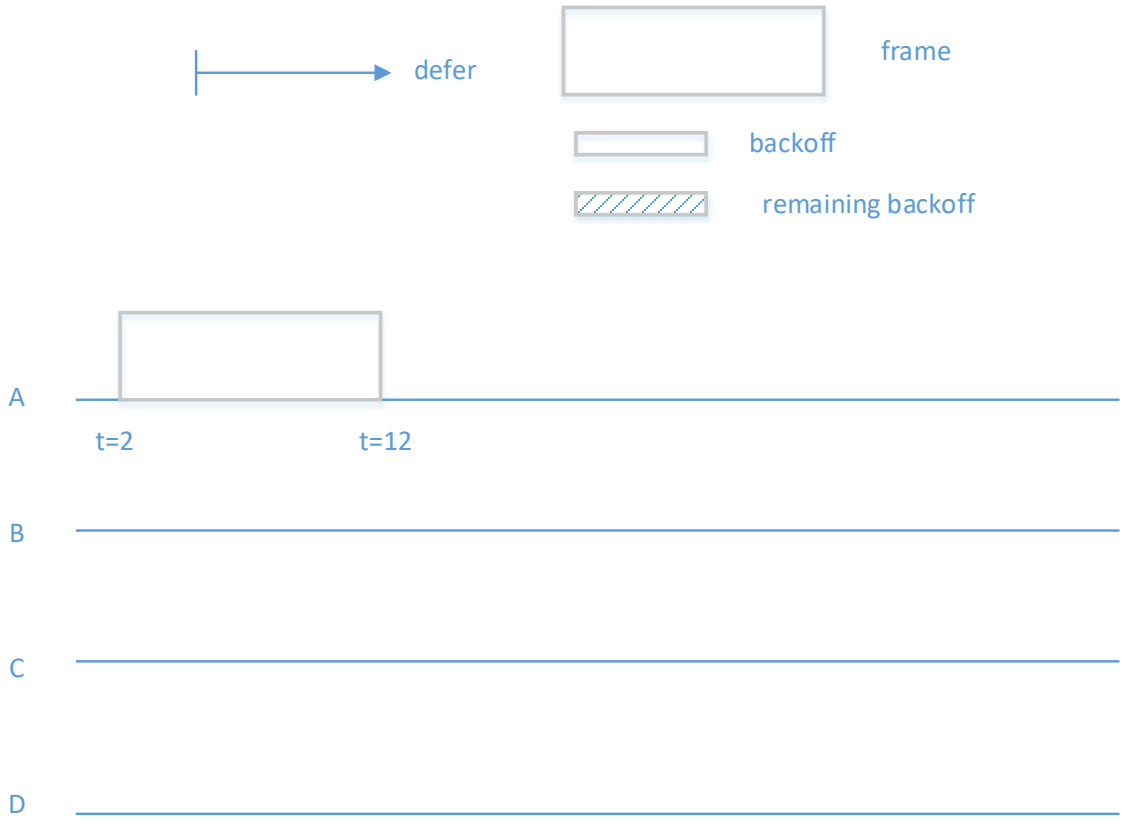
14 There are three nodes in a wireless LAN. Each node transmits frames according to the CSMA/CA protocol. Station A starts transmitting a frame at time t=2 ms. For stations B, C and D, a frame arrives at its MAC layer, respectively, from the upper layer at the times specified in the following table. The frame lengths are all equal and the transmission time of each frame is 10 ms. The backoff period of each station is also given in the table.

Station	Frame arrival time (ms)	Backoff period (ms)
B	3	10
C	5	5
D	20	3

Complete the following diagram using the provided legends, showing the timings of backoff and transmission activities of Stations B and C. Assume that DIFS=1 ms.



[6 marks]

-END-