44100113: COMPUTER NETWORKS
HOMEWORK 4: CHAPTER 5 Link Layer
SOLUTIONS

Notes: All exercises are in accordance with the 6th edition (International Edition). We change data values in some problems, which are highlighted.

Exercise 1 (R2)
Although each link guarantees that an IP datagram sent over the link will be received at the other end of the link without errors, it is not guaranteed that IP datagrams will arrive at the ultimate destination in the proper order. With IP, datagrams in the same TCP connection can take different routes in the network, and therefore arrive out of order. TCP is still needed to provide the receiving end of the application the byte stream in the correct order. Also, IP can lose packets due to routing loops or equipment failures.

Exercise 2 (R3)
Framing: there is also framing in IP and TCP; link access;
Reliable delivery: there is also reliable delivery in TCP;
Flow control: there is also flow control in TCP;
Error detection: there is also error detection in IP and TCP; error correction;
Full duplex: TCP is also full duplex.

Exercise 3 (R10)
C's adapter will process the frames, but the adapter will not pass the datagrams up the protocol stack. If the LAN broadcast address is used, then C's adapter will both process the frames and pass the datagrams up the protocol stack.

Exercise 4 (R11)
An ARP query is sent in a broadcast frame because the querying host does not which adapter address corresponds to the IP address in question. For the response, the sending node knows the adapter address to which the response should be sent, so there is no need to send a broadcast frame (which would have to be processed by all the other nodes on the LAN).

Exercise 5 (P1)
1 1 1 0 1
0 1 1 0 0
1 0 0 1 0
1 1 0 1 1
1 1 0 0 0

**Exercise 6 (P14)**
a), b) See figure below.
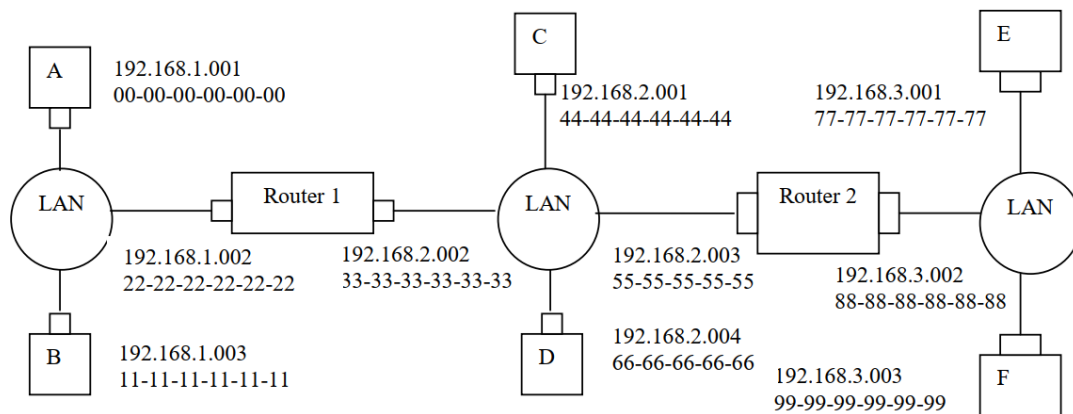
c)

1. Forwarding table in E determines that the datagram should be routed to interface 192.168.3.002.

2. The adapter in E creates and Ethernet packet with Ethernet destination address 88-88-88-88-88-88.

3. 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.

4. 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.

5. The process continues until the packet has reached Host B

d) ARP in E must now determine the MAC address of 198.162.3.002. Host E sends out an ARP query packet within a broadcast Ethernet frame. Router 2 receives the query packet and sends to Host E an ARP response packet. This ARP response packet is carried by an Ethernet frame with Ethernet destination address 77-77-77-77-77-77.

Exercise 7 (P18)

At $t = 0$ A transmits. At $t = 576$, A would finish transmitting. In the worst case, B begins transmitting at time t=324, which is the time right before the first bit of A's frame arrives at B. At time t=324+325=649 B 's first bit arrives at A . Because 649> 576, A finishes transmitting before it detects that B has transmitted. So A incorrectly thinks that its frame was successfully transmitted without a collision.

Exercise 8 (P21)
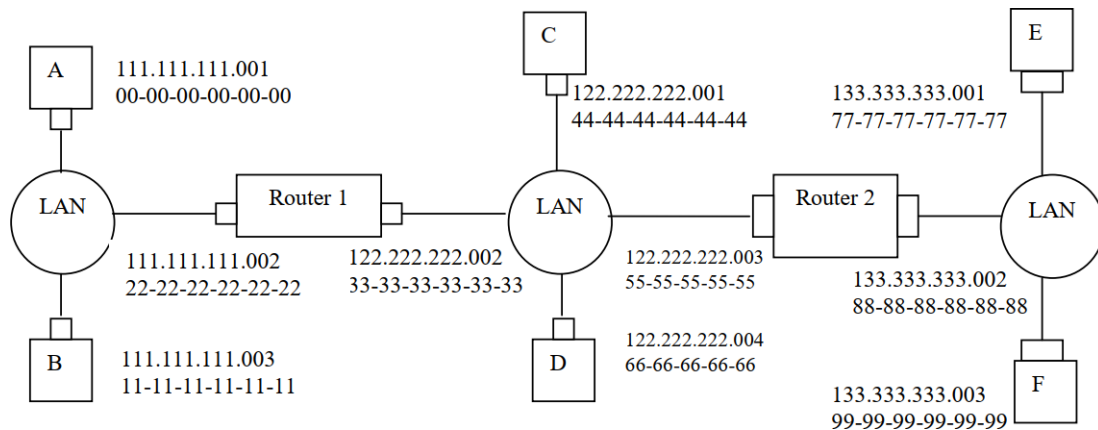
i) from A to left router:
   Source MAC address: 00-00-00-00-00-00
   Destination MAC address: 22-22-22-22-22-22
   Source IP: 111.111.111.001
   Destination IP: 133.333.333.003

ii) from the left router to the right router:
   Source MAC address: 33-33-33-33-33-33
   Destination MAC address: 55-55-55-55-55-55
   Source IP: 111.111.111.001
   Destination IP: 133.333.333.003

iii) from the right router to F:
   Source MAC address: 88-88-88-88-88-88
   Destination MAC address: 99-99-99-99-99-99
   Source IP: 111.111.111.001
   Destination IP: 133.333.333.003

Exercise 9 (P22)
i) from A to left router:
   Source MAC address: 00-00-00-00-00-00
   Destination MAC address: 55-55-55-55-55-55
   Source IP: 111.111.111.001
   Destination IP: 133.333.333.003

ii) from the switch to the right router:
   Source MAC address: 00-00-00-00-00-00
   Destination MAC address: 55-55-55-55-55-55
   Source IP: 111.111.111.001
   Destination IP: 133.333.333.003

iii) from the right router to F:

Source MAC address: 88-88-88-88-88-88
Destination MAC address: 99-99-99-99-99-99
Source IP: 111.111.111.001
Destination IP: 133.333.333.003