1. Consider the **5-bit** generator, **G = 10011**, and suppose that D has the value **1010101010**. What is the value of R?
   10101010100000 (append 4 zeros)
   10101010100000 / 10011 = 101101110 with **100 R**

2. Recall that with the CSMA/CD protocol, the adapter waits **K * 512 bit times** after a collision, where K is drawn randomly. For **K = 100**, how long does the adapter wait until returning to Step 2 for a **10 Mbps** broadcast channel? For a **100 Mbps** broadcast channel?
   Wait = K * 512 (over 10 Mbps) = (100 * 512) / (10 * 10^6) = **5.12 msec**
   Wait = K * 512 (over 100 Mbps) = (100 * 512) / (100 * 10^6) = **5.12 usec**

3. Suppose nodes A and B are on the same **10 Mbps** broadcast channel, and the propagation delay between the two nodes is **245 bit times**. Suppose A and B send Ethernet frames at the same time, the frames collide, and then A and B choose different values of K in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide?

   For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at **t = 0 bit times**. They both detect collisions at **t = 245t bit times**. Suppose **KA = 0** and **KB = 1**. At what time does B schedule its retransmission? At what time does A begin transmission? (Note: The nodes must wait for an idle channel after returning to Step 2 - see protocol.) At what time does A's signal reach B? Does B refrain from transmitting at its scheduled time?

Time	What Happens?
0	Begin Transmission
245	Detect collision
293	Finish transmitting jam signal
293 + 245 = 538	Last bit of B arrives at A
538 + 96 = 634	A starts transmitting
293 + 512 = 805	**B senses (96 bits) before transmitting**
634 + 245 = 879	A reaches B

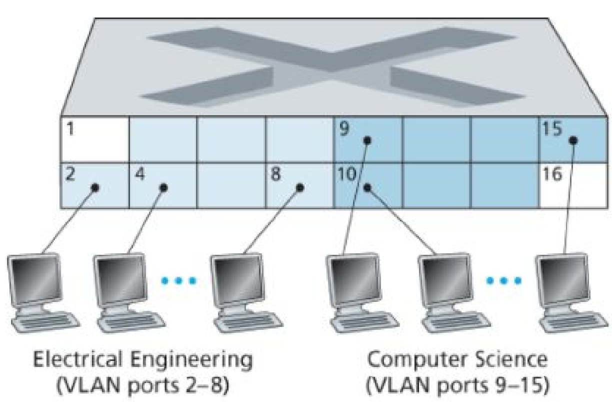
   B avoids transmitting (at 805 + 96) when A is transmitting. Hence, they **do not collide.**

4. Let’s consider the operation of a learning switch in the context of a network in which **6 nodes** labeled A through F are star connected into an Ethernet switch.
   Suppose that
   1. B sends a frame to E,
   2. E replies with a frame to B,
   3. A sends a frame to B,
   4. B replies with a frame to A.

   The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.

Operation	Switch table	Forwarded to	Justification
1	Learns MAC address of B	A, C, D, E, F	Table is empty, does not know E yet
2	Learns MAC address of E	B	Already knows B
3	Learns MAC address of A	B	Already knows B
4	-	A	Already knows A

5. Consider the single switch VLAN in **Figure 6.25**, and assume an external router is connected to **switch port 1**. Assign IP addresses to the EE and CS hosts and router interface. Trace the steps taken at both the network layer and the link layer to transfer an IP datagram from an EE host to a CS host (Hint: Reread the discussion of **Figure 6.19** in the text).



EE IPs (VLAN 11):
111.111.1.1
111.111.1.2
111.111.1.3
CS IP’s (VLAN 12):
111.111.2.1
111.111.2.2
111.111.2.3

The router's interface card can contain two sub-interface IP addresses (111.111.1.0 and 111.111.2.0, EE and CS respectively).
Assuming that a host from EE with IP of 111.111.1.1 is sending an IP datagram to a CS host (111.111.2.1), the process is as follow:

1. EE host encapsulates IP datagram into a frame
   -destination MAC = MAC of router's interface card that connects port 1
2. Router receives frame and passes it to IP layer
   -decides IP datagram should be forwarded via subinterface 111.111.2.0
3. Router encapsulates IP datagram into frame and sends it to port 1
   -with 802.1q tag VLAN ID 12
4. Switch receives frame at port 1
   -identifies frame with VLAN ID 12, and sends it to CS host
5. CS host receives frame
   -removes tag

6. In step 4 of the CSMA/CA protocol, a station that successfully transmits a frame begins the CSMA/CA protocol for a second frame at step 2, rather than at step 1. What rationale might the designers of CSMA/CA have had in mind by having such a station not transmit the second frame immediately (if the channel is sensed idle)?
   Let's say a station is initially the only station transmitting, but halfway through it's first frame, another station wants to transmit as well. Before transmitting, the second station will sense that the channel is busy and obtain a random backoff value. The first station goes back to step 1 for it's second frame. The second station will still be waiting for an idle channel in backoff. In this scenario, the first station will get to transmit all of its frames before the second station even gets access to the channel. However, if the first station goes on to step 2, the second station gets a chance to transmit it's frames and the two stations can evenly share the channel. **Every station gets a fair chance.**

7. Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit **1,000 bytes** of data, and all other stations are idle at this time. As a function of SIFS and DIFS, and ignoring the propagation delay and assuming no bit error, calculate the time required to transmit the frame and receive the acknowledgement.
   R = 11 Mbps
   802.11 without data = 32 bytes, 256 bits
   T(RTS) = T(ACK) = T(CTS) = 256 / 11 = 23 usec
   T(trans) = ((1000*8)+(32*8)) / (11*10^6) = 751 usec
   DIFS + T(RTS) + T(CTS) + T(trans) + T(ACK) + 3SIFS = **DIFS + 820usec + 3SIFS**