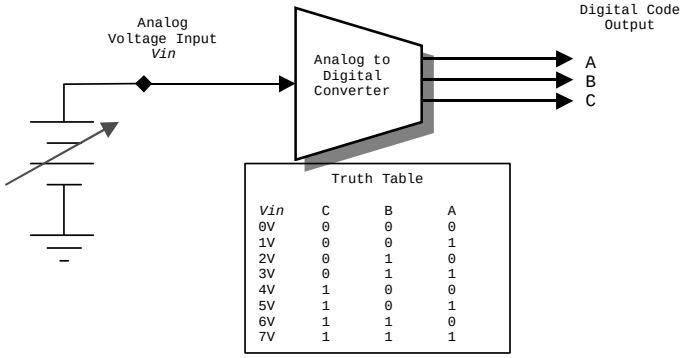
ECT-215 Homework #1 Solution Set

Chapter 14 Problems 1-29

Scoring: 1 point per problem, 29 points total.

1. *For the system of figure 14-1, give the binary code output that will result for each of the following voltages: 3V; 3.7V; 6V; 6.2V.*



Truth Table

Vin	C	B	A
0V	0	0	0
1V	0	0	1
2V	0	1	0
3V	0	1	1
4V	1	0	0
5V	1	0	1
6V	1	1	0
7V	1	1	1

[Figure 14-1]

When Vin = 3V, CBA = {011}
When Vin = 3.7V, CBA = {100} (Same as code for 4V)
When Vin = 6V, CBA = {110}
When Vin = 6.2V, CBA = {110} (Same as code for 6V)

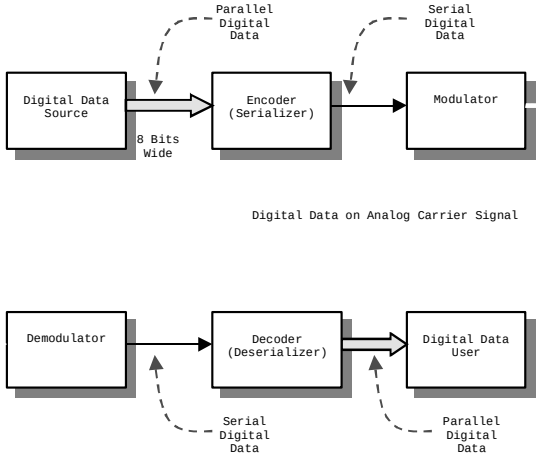
2. *What is meant by the term quantization*?

Quantization is the reduction of information with an infinite number of possible values (like a voltage) into something with a *finite* (countable) number of values.

3. *A certain digital system uses 5 bits per sample. How many voltages can it represent*?

The system can represent 2^5 or 32 different voltages.

4. *Draw a block diagram of a complete data communications system, and using outline form, explain the function of each part.*



[Figure 14-2]

Function of components of problem 4:

A. Transmitter operation
   1. Parallel data from source converted to serial.
   2. Serial data converted to analog (if needed) for transmission by modulator.

B. Receiver operation
   1. Incoming analog data converted back to digital by demodulator.
   2. Deserializer converts serial data back to parallel.

5. *Explain the difference between serial and parallel data. Give a non-electronic example to illustrate.*

   In parallel data, all data bits are sent at once. With serial data, one data bit is sent at a time. A good everyday example is cars moving on a road; a multi-lane road can support the equivalent of parallel data transfer.

6. *What must be done in order to pass digital information through an analog medium (such as a telephone line)?*

   The information must be converted into an analog form to be passed through an analog medium.

7. *A data waveform has a bit time T_b of 1 μS. Calculate the data rate of this waveform.*

$$bps = \frac{1}{T_b} = \frac{1}{1\mu S} = \underline{\underline{1Mb/s}}$$

8. *In order to simulate a "1010. . ." serial data pattern at 4800 bps, what frequency square wave must be used?*

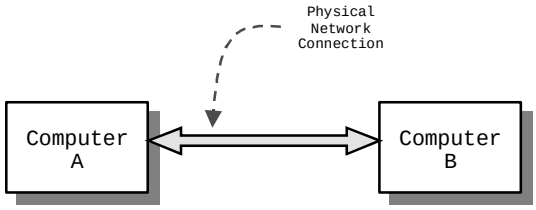
$$f_{sim} = \frac{bps}{2} = \frac{4800bps}{2} = \underline{\underline{2400Hz}}$$

9. *Define the terms simplex, half duplex, and full duplex. Which mode usually requires the most bandwidth?*

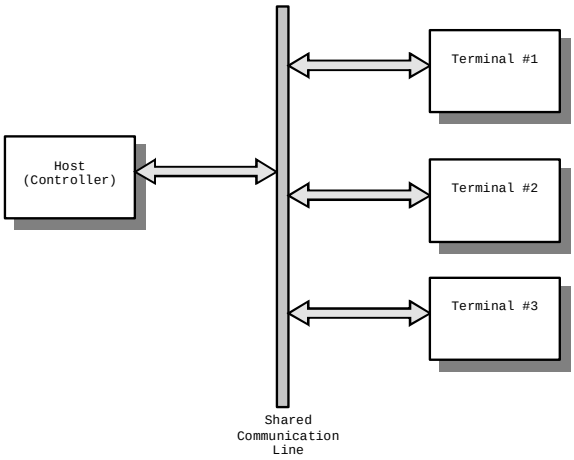
Simplex: Communications occurs in only one direction.
Half Duplex: Communications occurs in two directions, but only one at a time.
Full Duplex: Communications in both directions at the same time.

Full duplex communications usually requires the most bandwidth.

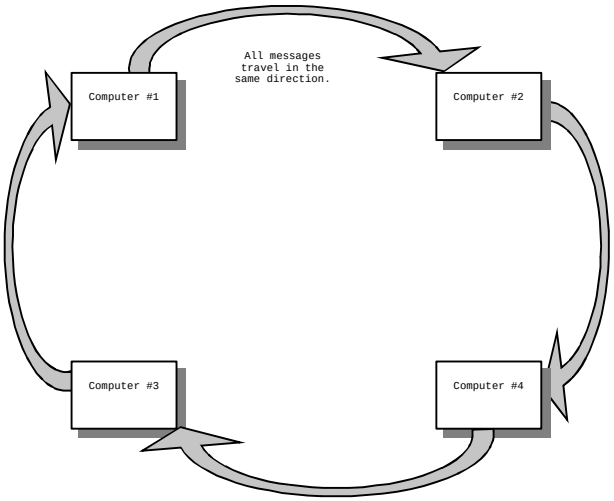
10. *Draw a diagram of a point-to-point, multi-drop, ring, and star network. Which of these has the highest reliability?*



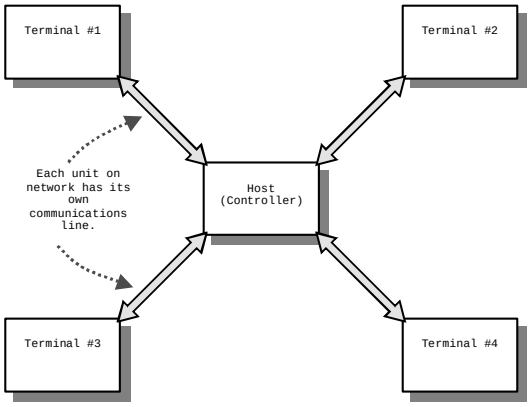
Point to point: [Figure 14-5]



Multi-drop: [Figure 14-6]



Ring: [Figure 14-8]



Star: [Figure 14-7]

The star network has the best reliability of all the networks listed.

11. *Define the term protocol.*

    A protocol is a set of rules for communication.

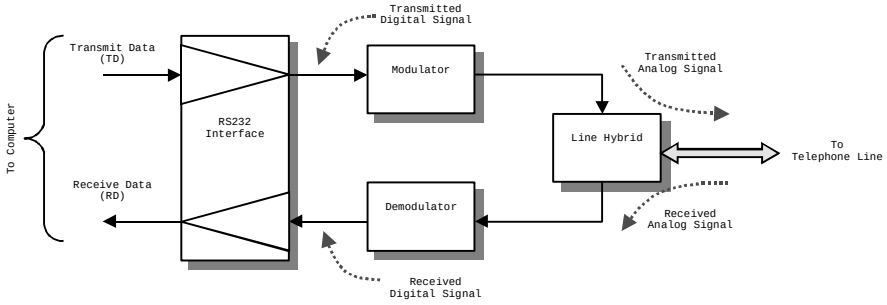
12. *Using outline form, explain how a message is originated and delivered on a ring network.*

    A. Unit waits for token which is equal to permission to send.
    B. Transmitting unit stores token and releases message frame.
    C. Message frame circulates network and is marked received by recipient, then retransmitted.
    D. Originator gets message back, checks status bits.
        1. If receiver got message OK, token is released back onto network to allow other units to transmit.

13. *What does CSMA/CD stand for? Summarize the operation of units on a CSMA/CD network in one sentence.*

CSMA/CD stands for Carrier Sense Multiple Access with Collision Detect. The operation can be summarized as "listen before you speak."

14. *Draw a block diagram of a telephone modem. For each signal in your diagram, show whether it is analog or digital.*



[Figure 14-11]

15. *What is the frequency response of a standard dial-up telephone line?*

A standard dial-up line responds from 300 Hz to 3 KHz.

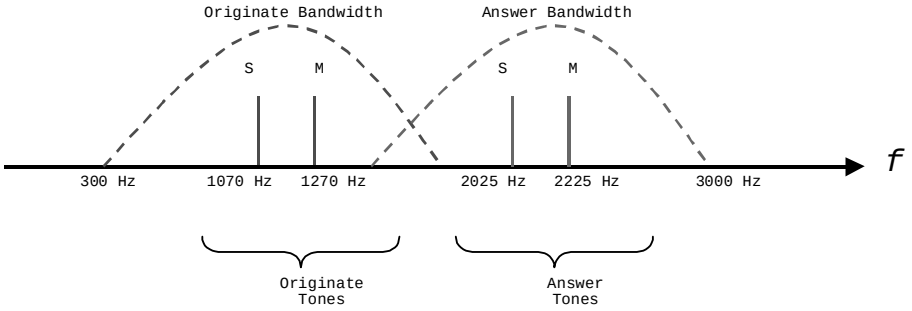
16. *What will happen when the following signals are passed into a telephone line?*
a) A 1000 Hz Sine wave *b) A 2.5 KHz square wave*
c) A 4000 Hz Sine wave

a) The 1000 Hz sine wave passes to the other end unchanged.
b) A 2.5 KHz sine wave appears at the other end, since only the 2.5 KHz fundamental can pass down the line.
c) There is no output at the other end, as 4000 Hz is above the upper frequency limit.

17. *What is meant by the terms mark and space?*

Mark means a logic "1," and *space* means a logic "0."

18. *Draw a spectrogram showing the frequencies transmitted by originate and answer modems according to the Bell 103 standard.*



[Figure 14-15]

19. *Define the term BAUD. How are BAUD and bps different?*

BAUD is the rate at which changes are made on an analog carrier wave. It is quite different than *data rate*, which is measured in *bits per second*, or *bps*. Units of *bps* essentially describe a digital quantity, while *BAUD* describes an analog quantity.

20. *What is a single-level modulation system?*

A single-level modulation system represents one bit of data for each transition (change) in the analog modulated waveform.

21. *A 4800 bps data waveform is being sent into a FSK modulator. What bandwidth will the resulting signal need?*

Since FSK is a single-level system, the BAUD is equal to the data rate:

$$BW_{FSK} \approx 5BAUD \approx 5(4800BAUD) \approx \underline{\underline{24KHz}}$$

22. *A certain communication channel has a 2 KHz bandwidth. What is the maximum signaling rate and data possible if single-level FSK is used?*

$$BW_{FSK} \approx 5BAUD \Rightarrow BAUD_{\max} \approx \frac{BW}{5} \approx \frac{2KHz}{5} \approx \underline{\underline{400BAUD}}$$

Because FSK is a single-level system, the data rate will be equal to the signalling rate at <u>400 BPS</u>.

23. *What is a multi-level modulation system? What is the advantage of a multi-level system over a single-level system?*

A multi-level modulation system encodes more than 1 bit per transition. The advantage of these systems is higher speed.

24. *A certain multi-level modulation system encodes 3 bits per transition, and operates at 600 BAUD. What is the actual data rate*?

$$bps = m \times BAUD = (3)(600BAUD) = \underline{\underline{1800bps}}$$

25. *What factor limits the number of bits per transition in multi-level systems*?

The signal to noise ratio (SNR) of the communications channel limits the number of bits per transition.

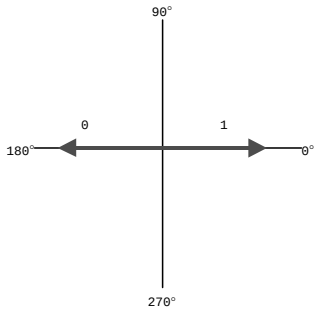
26. *What two factors limit the data carrying capacity of a communications channel*?

The two factors that limit channel capacity are the SNR ratio and bandwidth.

27. *Explain why PSK is much more popular than FSK for modern high-speed modems*.

PSK is much easier to generate and demodulate, and uses bandwidth much more efficiently than FSK.

28. *Draw a signal constellation diagram for a single-level (binary) PSK system. How many modulation states does it have*?



[Partial of Figure 14-18]

This constellation has 2 modulation states.

29. *In order for a PSK modulator to encode 5 bits per transition, how many phase angles must it have*?

The constellation needs 2^5 or 32 distinct phase angles.