CHAPTER 4

Digital Transmission

Review Questions

1.
   unipolar, 2
   NRZ-L, 2
   NRZ-I, 2
   RZ, 3
   Manchester, 2
   differential Manchester, 2
   AMI, 3
   2B1Q, 4
   MLT-3, 3
2. The DC component is the constant portion of a signal.
3. The bit rate is always greater than or equal to the pulse rate because a pulse contains one or more bits.
4. The receiver may have trouble determining the beginning and end of each bit.
5. In NRZ-L the signal depends on the state of the bit: a positive voltage is usually a 0, and the negative a 1. In NRZ-I the signal is inverted when a 1 is encountered.
6. The major disadvantage of NRZ encoding is the lack of a synchronization method for long streams of 0s or 1s. Both RZ and biphase encoding feature a signal change at the middle of each bit that is used for synchronization.
7. Both methods convert digital data into digital signals. In RZ, a 1 bit is represented by positive-to-zero, and 0 by negative-to-zero, whereas in bipolar AMI a 0 is represented by a zero voltage, while 1 is represented by alternating positive and negative values.
8. The three major steps in block coding are division, substitution, and line coding.
9. If you select a code that minimizes the number of consecutive 0s or 1s, this could help in synchronization.

10. If you select a code that features unused sequences of bits, this could help in error detection.
11. The higher the number of samples taken the more accurate the digital reproduction of an analog signal. However, there is an upper limit.
12. The higher the number of bits allotted for each sample the more precise the digital representation of the signal will be.
13. The Nyquist theorem says the sampling rate must be at least twice the highest frequency of the original signal.
14. In parallel mode, bits are grouped together and transmitted simultaneously over separate communication lines. In serial mode, all bits are transmitted over only one communication line and one bit follows another.
15. Advantage: increase of transmission speed and therefore efficiency. Disadvantage: cost of multiple communication lines.
16. In asynchronous transmission, there is no timing needed at the byte level, because information is received and translated by agreed-upon patterns. This method is mostly used for low-speed communication. In synchronous transmission, timing is very important. This method is very fast and used for high-speed transmissions.

Multiple-Choice Questions

17. a
18. c
19. d
20. d
21. c
22. d
23. d
24. d
25. c
26. a
27. a
28. d
29. b
30. c
31. b
32. d
33. a
34. d
35. c
36. d
37. a
38. b

39. d

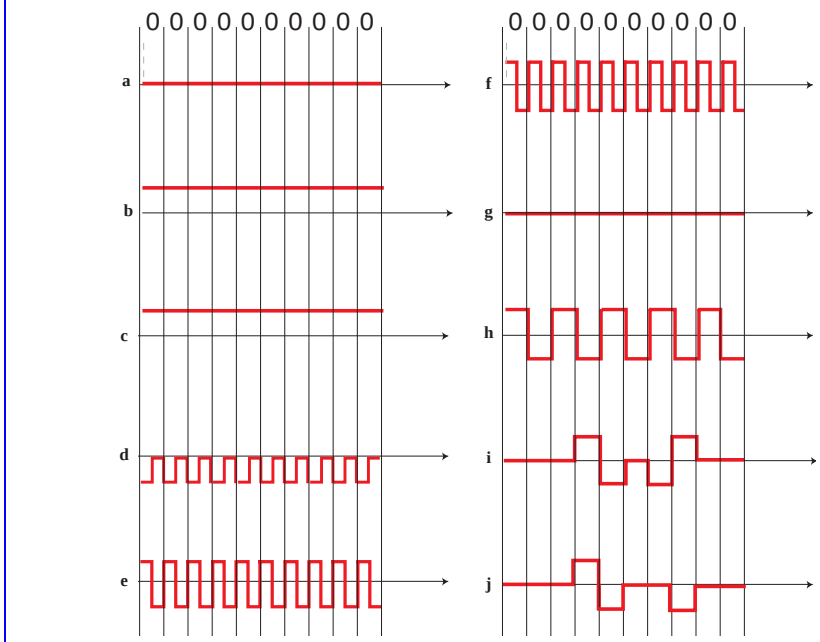
Exercises

40.

a. 5 s: 5000 bits
b. 1/5 s: 200 bits
c. 100 ms: 100 bits

41. See Figure 4.1

Figure 4.1 *Exercise 41*



42. See Figure 4.2
43. See Figure 4.3
44. See Figure 4.4
45. 00100100
46. 11001001
47. 00101101 (assuming the first bit is 0)
48. 01110011
49. 00011100
50. 10010010 (assuming no transition at the beginning)
51. 10001001

Figure 4.2 *Exercise 42*

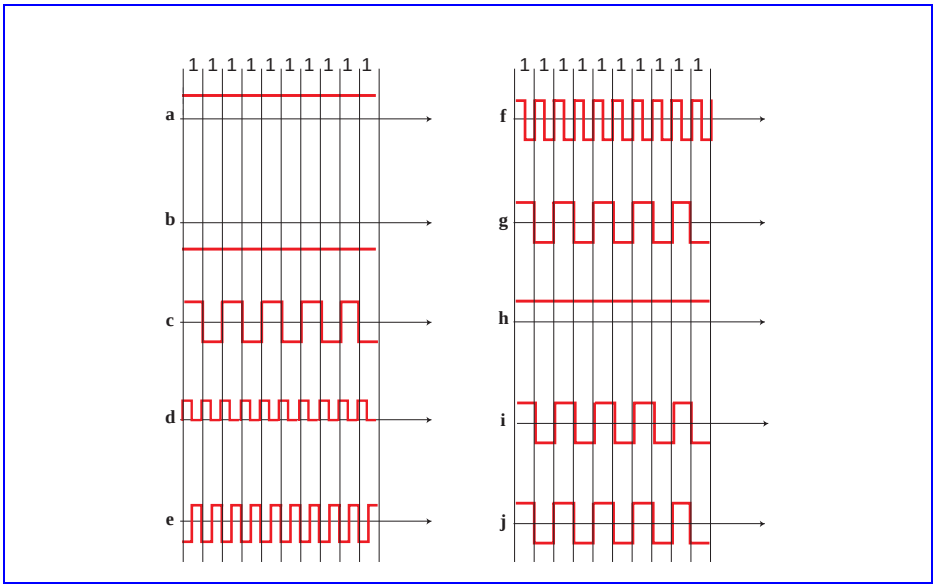
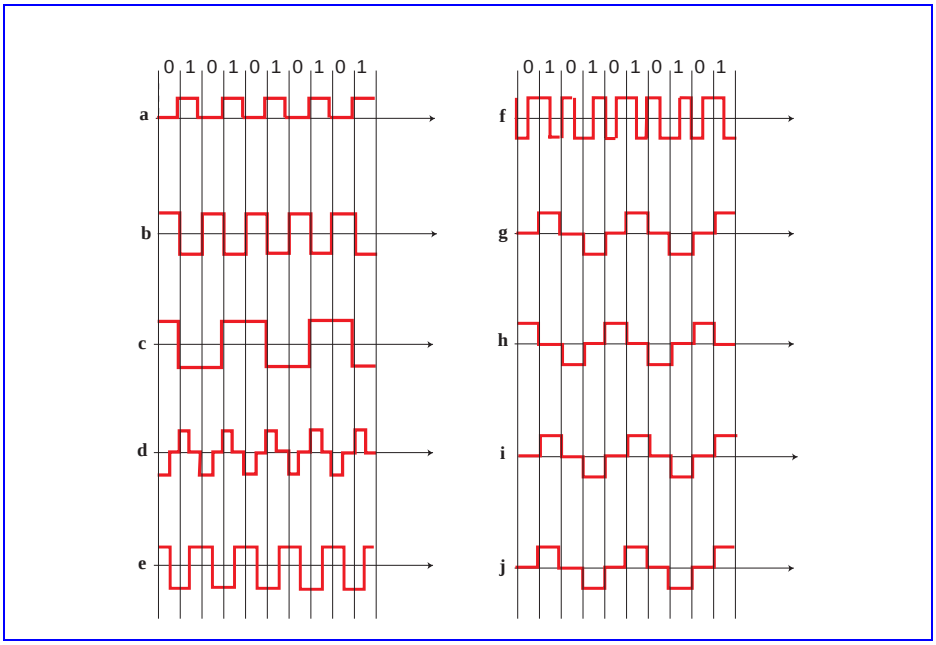


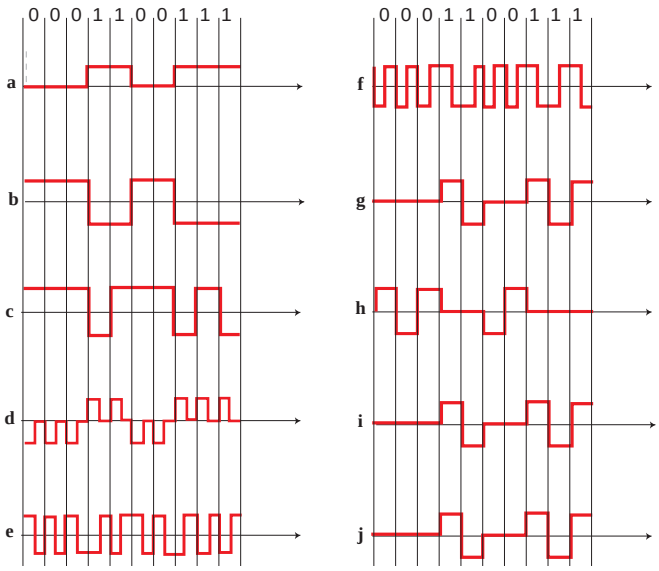
Figure 4.3 *Exercise 43*



52.

a. 1 level (plus one zero voltage)
b. 2 levels
c. 2 levels

Figure 4.4 *Exercise 44*



d. 2 levels (plus zero voltage for half of each bit interval)

e. 2 levels

f. 2 levels

53. 8,000 samples per second

54.

a. Not enough information is given (highest frequency is unknown)

b. 12,000 samples per second

c. Theoretically, the sampling rate is 0. However, this is a special case where one sample will do the job.

d. The frequency is infinity; the sampling rate is infinite (you cannot sample this type of signal).

55. 1/8000 = 0.125 ms

56. 8000 samples/sec

57. Two bits per sample: bit rate = 8,000 × 2 = 16,000.

58. For seven-bit ASCII: 7000 bits for data, 1000 stop bits, 1000 start bits, for a total of 9000 bits. This means 78% of bits transmitted are data (7000/9000). Note that if a parity bit is used to make each character eight bits long, the calculation would be different.