Summary

In this chapter, we have learned the following:

1. Numeric quantities occur naturally in analog form but must be converted to digital form to be used by computers or digital circuitry.

2. The binary numbering system is used in digital systems because the 1s and 0s are easily represented by ON or OFF transistors, which output 0 V for 0 and 5 V for 1.

3. Any number system can be converted to decimal by multiplying each digit by its weighting factor.

4. The weighting factor of the least significant digit in any numbering system is always 1.

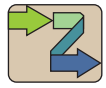
5. Binary numbers can be converted to octal by forming groups of 3 bits and to hexadecimal by forming groups of 4 bits, beginning with the LSB. Each group is then converted to an octal or hex digit.

6. The successive-division procedure can be used to convert from decimal to binary, octal, or hexadecimal.

7. The binary-coded-decimal system uses groups of 4 bits to drive decimal displays such as those in a calculator.

8. ASCII is used by computers to represent all letters, numbers, and symbols in digital form.

Glossary



Helpful Hint

Skimming through the glossary terms is a good way to review the chapter. You should also feel that you have a good understanding of all the topics listed in the objectives at the beginning of the chapter.

Alphanumeric: Characters that contain alphabet letters as well as numbers and symbols.

Analog: A system that deals with continuously varying physical quantities such as voltage, temperature, pressure, or velocity. Most quantities in nature occur in analog, yielding an infinite number of different levels.

ASCII Code: American Standard Code for Information Interchange. ASCII is a 7-bit code used in digital systems to represent all letters, symbols, and numbers to be input or output to the outside world.

BCD: Binary-coded decimal. A 4-bit code used to represent the 10 decimal digits 0 to 9.

Binary: The base 2 numbering system. Binary numbers are made up of 1s and 0s, each position being equal to a different power of 2 (2^3, 2^2, 2^1, 2^0, and so on).

Bit: A single binary digit. The binary number 1101 is a 4-bit number.

Decimal: The base 10 numbering system. The 10 decimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Each decimal position is a different power of 10 (10^3, 10^2, 10^1, 10^0, and so on).

Digital: A system that deals with discrete digits or quantities. Digital electronics deals exclusively with 1s and 0s or ONs and OFFs. Digital codes (such as ASCII) are then used to convert the 1s and 0s to a meaningful number, letter, or symbol for some output display.

Hexadecimal: The base 16 numbering system. The 16 hexadecimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. Each hexadecimal position represents a different power of 16 (16^3, 16^2, 16^1, 16^0, and so on).

Least Significant Bit (LSB): The bit having the least significance in a binary string. The LSB will be in the position of the lowest power of 2 within the binary number.

Most Significant Bit (MSB): The bit having the most significance in a binary string. The MSB will be in the position of the highest power of 2 within the binary number.

Octal: The base 8 numbering system. The eight octal numbers are 0, 1, 2, 3, 4, 5, 6, and 7. Each octal position represents a different power of 8 (8^3, 8^2, 8^1, 8^0, and so on).

Problems

Section 1–4

1–1. Convert the following binary numbers to decimal.

(a) 0110 **(b)** 1011 **(c)** 1001 **(d)** 0111
(e) 1100 **(f)** 0100 1011 **(g)** 0011 0111
(h) 1011 0101 **(i)** 1010 0111 **(j)** 0111 0110

Section 1–5

1–2. Convert the following decimal numbers to 8-bit binary.

(a) 186_{10} **(b)** 214_{10} **(c)** 27_{10} **(d)** 251_{10} **(e)** 146_{10}

Sections 1–6 and 1–7

1–3. Convert the following binary numbers to octal.

(a) 011001 **(b)** 11101 **(c)** 1011100
(d) 01011001 **(e)** 1101101

1–4. Convert the following octal numbers to binary.

(a) 46_8 **(b)** 74_8 **(c)** 61_8 **(d)** 32_8 **(e)** 57_8

1–5. Convert the following octal numbers to decimal.

(a) 27_8 **(b)** 37_8 **(c)** 14_8 **(d)** 72_8 **(e)** 51_8

1–6. Convert the following decimal numbers to octal.

(a) 126_{10} **(b)** 49_{10} **(c)** 87_{10} **(d)** 94_{10} **(e)** 108_{10}

Sections 1–8 and 1–9

1–7. Convert the following binary numbers to hexadecimal.

(a) 1011 1001 **(b)** 1101 1100 **(c)** 0111 0100
(d) 1111 1011 **(e)** 1100 0110

1–8. Convert the following hexadecimal numbers to binary.

(a) $C5_{16}$ **(b)** FA_{16} **(c)** $D6_{16}$ **(d)** $A94_{16}$ **(e)** 62_{16}

1–9. Convert the following hexadecimal numbers to decimal.

(a) 86_{16} **(b)** $F4_{16}$ **(c)** 92_{16} **(d)** AB_{16} **(e)** $3C5_{16}$

1–10. Convert the following decimal numbers to hexadecimal.

(a) 127_{10} **(b)** 68_{10} **(c)** 107_{10} **(d)** 61_{10} **(e)** 29_{10}

Section 1–10

1–11. Convert the following BCD numbers to decimal.

(a) $1001\ 1000_{BCD}$ **(b)** $0110\ 1001_{BCD}$ **(c)** $0111\ 0100_{BCD}$
(d) $0011\ 0110_{BCD}$ **(e)** $1000\ 0001_{BCD}$

1–12. Convert the following decimal numbers to BCD.

(a) 87_{10} **(b)** 142_{10} **(c)** 94_{10} **(d)** 61_{10} **(e)** 44_{10}

1–13. Fill in all of the empty cells in Table P1–13 by performing the indicated conversion as shown in the row labeled "sample."

1–14. Fill in all of the empty cells in Table P1–14 by performing the indicated conversion as shown in the row labeled "sample."

TABLE P1–13

	Decimal	Binary	Octal	BCD	Hexadecimal
Sample	16	0001 0000	020	0001 0110	10
(a)	35				
(b)		0010 1001			
(c)			053		
(d)				0111 1000	
(e)					3A

TABLE P1–14

	Decimal	Binary	Octal	BCD	Hexadecimal
Sample	59	0011 1011	073	0101 1001	3B
(a)					44
(b)				1001 1000	
(c)			127		
(d)		0011 0100			
(e)	45				

Section 1–12

1–15. Use Table 1–5 to convert the following letters, symbols, and numbers to ASCII.

(a) % **(b)** $14 **(c)** N-6 **(d)** CPU **(e)** Pg

1–16. Insert a zero in the MSB of your answers to Problem 1–13, and list your answers in hexadecimal.

Section 1–13

C* **1–17.** The computer monitoring system at the geothermal facility shown in Figure 1–7 is receiving the following warning codes. Determine the problems that exist for each code (H stands for hex).

(a) $0010\ 0001_2$ **(b)** $C0_{16}$ **(c)** 88H **(d)** 024_8 **(e)** 48_{10}

C **1–18.** What is the BCD representation that is sent to a three-digit display on a voltmeter that is measuring 120 V?

C **1–19.** A computer programmer observes the following hex string when looking at a particular section of computer memory: 736B753433.

(a) Assume that the memory contents are ASCII codes with leading zeros and translate this string into its alphanumeric equivalent.

(b) The programmer realizes that the program recognizes only capital (uppercase) letters. Convert all letters in the alphanumeric equivalent to capital letters, and determine the new hex string.

*The letter C signifies problems that are more Challenging and thought provoking.