PROBLEMS

3-1. Convert the following binary numbers to decimal: 101110; 1110101; and 110110100.

3-2. Convert the following numbers with the indicated bases to decimal: $(12121)_3$; $(4310)_5$; $(50)_7$; and $(198)_{12}$.

3-3. Convert the following decimal numbers to binary: 1231; 673; and 1998.

3-4. Convert the following decimal numbers to the bases indicated.
   a. 7562 to octal
   b. 1938 to hexadecimal
   c. 175 to binary

3-5. Convert the hexadecimal number F3A7C2 to binary and octal.

3-6. What is the radix of the numbers if the solution to the quadratic equation $x^2 - 10x + 31 = 0$ is $x = 5$ and $x = 8$?

3-7. Show the value of all bits of a 12-bit register that hold the number equivalent to decimal 215 in (a) binary; (b) binary-coded octal; (c) binary-coded hexadecimal; (d) binary-coded decimal (BCD).

3-8. Show the bit configuration of a 24-bit register when its content represents the decimal equivalent of 295: (a) in binary; (b) in BCD; (c) in ASCII using eight bits with even parity.

3-9. Write your name in ASCII using an 8-bit code with the leftmost bit always 0. Include a space between names and a period after a middle initial.

3-10. Decode the following ASCII code:

1001010 1001111 1001000 1001110 0100000 1000100 1001111 1000101

3-11. Obtain the 9's complement of the following eight-digit decimal numbers: 12349876; 00980100; 90009951; and 00000000.

3-12. Obtain the 10's complement of the following six-digit decimal numbers: 123900; 090657; 100000; and 000000.

3-13. Obtain the 1's and 2's complements of the following eight-digit binary numbers: 10101110; 10000001; 10000000; 00000001; and 00000000.

3-14. Perform the subtraction with the following unsigned decimal numbers by taking the 10's complement of the subtrahend.

a. 5250 − 1321 **b.** 1753 − 8640

c. 20 − 100 **d.** 1200 − 250

3-15. Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend.

a. 11010 − 10000 **b.** 11010 − 1101

c. 100 − 110000 **d.** 1010100 − 1010100

3-16. Perform the arithmetic operations (+42) + (−13) and (−42) − (−13) in binary using signed-2's complement representation for negative numbers.

3-17. Perform the arithmetic operations (+70) + (+80) and (−70) + (−80) with binary numbers in signed-2's complement representation. Use eight bits to accommodate each number together with its sign. Show that overflow occurs in both cases, that the last two carries are unequal, and that there is a sign reversal.

3-18. Perform the following arithmetic operations with the decimal numbers using signed-10's complement representation for negative numbers.

a. (−638) + (+785)

b. (−638) − (+185)

3-19. A 36-bit floating-point binary number has eight bits plus sign for the exponent and 26 bits plus sign for the mantissa. The mantissa is a normalized fraction. Numbers in the mantissa and exponent are in signed-magnitude representation. What are the largest and smallest positive quantities that can be represented, excluding zero?

3-20. Represent the number $(+46.5)_{10}$ as a floating-point binary number with 24 bits. The normalized fraction mantissa has 16 bits and the exponent has 8 bits.

3-21. The Gray code is sometimes called a reflected code because the bit values are reflected on both sides of any 2^n value. For example, as shown in Table 3-5, the values of the three low-order bits are reflected over a line drawn between 7 and 8. Using this property of the Gray code, obtain:

a. The Gray code numbers for 16 through 31 as a continuation of Table 3-5.

b. The excess-3 Gray code for decimals 10 to 19 as a continuation of the list in Table 3-6.

3-22. Represent decimal number 8620 in (a) BCD; (b) excess-3 code; (c) 2421 code; (d) as a binary number.

3-23. List the 10 BCD digits with an even parity in the leftmost position (total of five bits per digit). Repeat with an odd-parity bit.

3-24. Represent decimal 3984 in the 2421 code of Table 3-6. Complement all bits of the coded number and show that the result is the 9's complement of 3984 in the 2421 code.

3-25. Show that the exclusive-OR function $x = A \oplus B \oplus C \oplus D$ is an odd function. One way to show this is to obtain the truth table for $y = A \oplus B$ and for $z = C \oplus D$ and then formulate the truth table for $x = y \oplus z$. Show that $x = 1$ only when the total number of 1's in A, B, C, and D is odd.

3-26. Derive the circuits for a 3-bit parity generator and 4-bit parity checker using an even-parity bit. (The circuits of Fig. 3-3 use odd parity.)