**Chapter 1 Exercises (97 pts)**

**Sections 1.1-1.4**

1. Mark T (true) or F (false) the output of each of the following circuits with the given inputs. (3pts)

T F

F T

(a) (b)

T

T

(c)

1. Let’s say that two circuits are equivalent if they produce the same outputs for the same inputs. Draw a circuit equivalent to the one in Question 1-b using two NOT gates and one AND gate. (1pt)
2. Simplify the circuit in Question 1-c to an equivalent one that has only two gates: one NOT gate and one AND gate. (1pt)
3. A. Draw an alternative XOR circuit, different from the one in Figure 1-2, using two NOT gates, two OR gates, and one AND gate. \*\*Hint: at least one of the inputs, A or B, must be true, and at least one of the negated inputs, NOT A or NOT B, must be true too.\*\* (1pt)

B. Draw a third XOR circuit using four gates: one OR gate, two AND gates, and one NOT gate. (1pt)

1. (MC) computer memory is called RAM because (1pt)
   1. It provides rapid access to data.
   2. It is mounted on the motherboard.
   3. It is measured in megabytes.
   4. Its bytes can be addressed in random order.
   5. Its chips are mounted in a rectangular array.
2. Mark true or false and explain: (3pts)
   1. One meg of RAM can hold exactly as much information as one meg on a flash drive. \_\_\_\_\_
   2. A factory-formatted hard disk is split into a fixed number of files. \_\_\_\_\_
   3. In personal computers the operating system resides in ROM. \_\_\_\_\_
3. Find an old discarded desktop computer, **unplug the power cord**, and disconnect all other cables. Open the cover and identify the motherboard, CPU, RAM USB ports (sockets for cable connectors), hard disk, CD-ROM, and other components and adapters, if present. Take a picture of each and label. (5 pts)
4. Identify the following entities or devices as part of a computer system’s hardware (H) or software (S) (6pts)
   1. Operating system \_\_\_\_\_
   2. CPU \_\_\_\_\_
   3. GUI (Graphical User Interface) \_\_\_\_\_
   4. Bus \_\_\_\_\_
   5. RAM \_\_\_\_\_
   6. File \_\_\_\_\_
5. Identify the operating system that is running on your current computer and some software applications installed on it: a word processor, an Internet browser, a spreadsheet program, e-mail, an image processing application, games, and so on. (3 pts)

**Sections 1.5**

1. Mark true or false: (4pts)
   1. Only data but not CPU instructions can be stored in RAM. \_\_\_\_\_
   2. In ASCII code each character is represented in one byte. \_\_\_\_\_
   3. 16-bit binary numbers can be used to represent all non-negative integers from 0 to 216 -1. \_\_\_\_\_
   4. Programs stored in ROM are referred to as “firmware.” \_\_\_\_\_
2. What is the maximum number of different codes or numbers that can be represented in (3pts)
   1. 3 bits? \_\_\_\_\_
   2. 8 bits? \_\_\_\_\_
   3. 2 bytes? \_\_\_\_\_
3. Assuming that binary numbers represent unsigned integers in the usual way, with the least significant bit on the right, write the decimal value and the hex representation of the following binary numbers. (14 pts)

Example:

Binary Decimal Hex

00001000 8 08

00011100 28 1C

1. 00000010 \_\_\_\_\_ \_\_\_\_\_
2. 00000111 \_\_\_\_\_ \_\_\_\_\_
3. 10000000 \_\_\_\_\_ \_\_\_\_\_
4. 00001011 \_\_\_\_\_ \_\_\_\_\_
5. 11000011 \_\_\_\_\_ \_\_\_\_\_
6. 11110101 \_\_\_\_\_ \_\_\_\_\_
7. 00000101 10010010 \_\_\_\_\_ \_\_\_\_\_
8. An experiment consists of tossing a coin 10 times and its outcome is a sequence of heads and tails. How many possible outcomes are there? (2 pts)
9. How much memory does it take to hold a 512 by 512 gray-scale image with 256 levels of gray? (2pts)
10. When a printer runs out of paper, the eight-bit printer status register of the parallel interface adapter gets the following settings: bit 7 (leftmost bit), “BUSY” is set to 1; bit 5, “PE” (“paper end”), is set to 1; and bit 3, “ERROR,” is set to 0. Bit 4 is always 1 when a printer is connected; bit 6 is 0 and bits 0-2 are not used. Write the hex value equal to the setting of the printer status register when the printer runs out of paper, assuming that bits 0-2 are 0. (5 pts)
11. Design a method for representing the state of tic-tac-toe board in computer memory. Can you fit your representation into three bytes? (5 pts)
12. In the game of Nim, stones are arranged in piles of arbitrary size. Each player in turn takes a few stones from any one pile. Every player must take at least one stone on every turn. The player who takes the last stone win.

Games of this type always have a winning strategy. This strategy can be established by tagging all possible positions in the game with two tags, “plus” and “minus,” in such a way that any move from a “plus” position always leads to a “minus” position, and from any “minus” position there is always a possible move into some “plus” position. The final winning position must be tagged “plus.” Therefore, if the first player begins in a “minus” position, she can win by moving right away into a “plus” position and returning to a “plus” position on each subsequent move. If, however, the first player begins in a “plus” position, then the second player can win, provided he knows how to play correctly.

In Nim, we can convert the number of stones in each pile into a binary number and write these binary numbers in one column (so that the “units” digits are aligned on the right). We can tag the position “plus” if the number of 1s in each column is even and “minus” if the count of 1s in at least one column is odd. Prove that this method of tagging “plus” and “minus” positions defines a winning strategy. Who wins starting with four piles of 1, 3, 5, and 7 stones—the first or the second player? What’s the correct response if the first player takes five stones from the pile of 7? (5 pts)

1. The table below is called a *Greco\_Roman square*: each of the three Latin letters occurs exactly once in each row and each column; the same is true for each of the three Greek letters, and each Latin-Greek combination occurs exactly once in the table:

|  |  |  |
| --- | --- | --- |
| Aγ | Bα | Cβ |
| Bβ | Cγ | Aα |
| Cα | Aβ | Bγ |

Substitute the digits 0, 1, and 2 for A, B, C and for a, B, y (in any order). Convert the resulting base-3 numbers into decimal (base-10) numbers. The base-3 system uses only three digits: 0, 1, and 2. The numbers are presented as follows:

|  |  |
| --- | --- |
| Decimal | Base 3 |
| 0 | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 10 |
| 4 | 11 |
| 5 | 12 |
| 6 | 20 |
| 7 | 21 |
| 8 | 22 |
| 9 | 100 |
| … | … |

Add 1 to each number. You will get a table in which the numbers 1 through 9 are arranged in such a way that the sum of the numbers in each row and column is the same. Explain why you get this result and find a way to substitute the digits 0, 1, and 2 for letters so that the sum of numbers in each of the two diagonals is also the same as in the rows and columns. What you get then is called a *magic square*. Using a similar method, build a 5 by 5 magic square. (5 pts)

**Section 1.6**

1. (MC) What does TCP stand for? (1 pt)
   1. Telnet Control Program
   2. Transmission Control Protocol
   3. Transport Compression Protocol
   4. Telephone Connectivity Program
   5. None of the above
2. Are the following entities or devices hardware (H) or software (S)? (6 pts)
   1. Host \_\_\_\_\_
   2. LAN \_\_\_\_\_
   3. Browser \_\_\_\_\_
   4. Search engine \_\_\_\_\_
   5. Router \_\_\_\_\_
   6. TCP/IP Adapter \_\_\_\_\_
3. Find and explore the home pages of two Internet and World Wide Web pioneers. Write a short essay about what they did. (20 pts)