## COLLEGE OF Engineering – department of computer science

**Midterm**

**Question 1: *[About computer architecture and organization]* (5 pts)**

Mark the following statements by True (T) or False (F). No justification is required.

1. “How is the multiplication instruction implemented in a computer?” is part of the architecture of the computer.

2. “Does a computer have a division instruction?” is part of the organization of the computer.

3. The registers decide whether the next instruction will be executed or not.

4. When a program is running, the CPU executes instructions located in the hard-disk.

5. A supercomputer is a computer that does not need any input/output devices for human-machine communication.

6. 1 GB is equal to one million KB.

7. Old computers were bulky because they stored huge amount of data.

8. Assembly code is converted to high-level code before being finally converted to machine language.

9. The ISA of the Intel processor is different than the one of the AMD processor.

10. Computers might have many processors working in parallel.

11. The program counter is a register.

12. Some instructions, when executed, might result in the content of the main memory being modified.

**Question 2: *[Data representation]* (7.5 pts)**

1. What decimal value does the binary number 11001 have if it is interpreted as unsigned number? (1 pt)
2. What decimal value does the binary number 11001 have if it is on a computer using signed-magnitude notation? (1 pt)
3. What decimal value does the binary number 11001 have if it is on a computer using two’s complement notation? (1 pt)
4. How do we detect an overflow condition in signed numbers? (in other words, when does the flag overflow is set?) (1 pt)
5. Multiply 00110 by 2 without doing any multiplication. How did you do it? (1 pt)
6. Divide 00110 by 4 without doing any division. How did you do it? (1 pt)
7. Your computer is doing the following addition: 0100 + 0110 (binary numbers are signed here). Give the value of the flag **Carry**, the flag **Overflow** and say whether the result is **correct or not.** (1.5 pt)

**Question 3: *[Boolean algebra and digital logic]* (7.5 pts)**

1. Prove that (xy)’(x’+y)(y’+y) = x’
2. Using truth tables (1.5 pts)
3. Using Boolean identities (2 pts)
4. You are responsible for designing a circuit that will allow the dean of your college to determine whether to close the campus due to weather conditions. It the highway department has not salted the area roads, and there is ice on the roads, the campus will be closed. Regardless of whether there is ice or salt on the roads, if there is snow, the campus should be closed. In all other situations, the campus should remain open.

Based on the text above, complete the following truth-table: (1.5 pts)

|  |  |  |  |
| --- | --- | --- | --- |
| Ice (x) | Salt (y) | Snow (z) | Closed? |
| 0 | 0 | 0 |  |
| 0 | 0 | 1 |  |
| 0 | 1 | 0 |  |
| 0 | 1 | 1 |  |
| 1 | 0 | 0 |  |
| 1 | 0 | 1 |  |
| 1 | 1 | 0 |  |
|  |  |  |  |

1. Find the Boolean expression of **Closed.** (1 pt)
2. Draw the circuit of **Closed** (1.5 pts)

**Bonus:**

Simplify the expression in 2) a) and draw again the circuit