Key to Midterm Exam S2
Computer Architecture

Duration: 1 hr 30 min

Answer on the answer sheet only.
Do not show any calculation unless you are explicitly asked.
Do not use red ink.

Exercise 1 (5 points)

Answer on the answer sheet. Let us consider the following **10-bit** binary number: **1001011010_2**.

1. Write down its hexadecimal representation.
2. Assuming that it is an unsigned integer, write down its decimal representation.
3. Assuming that it is a signed integer, write down its decimal representation.

4. Write down the 8-bit binary representation of the following unsigned number: **128_{10}**.
5. Write down the 8-bit binary representation of the following signed number: **-128_{10}**.

6. Determine the minimum number of bits required to encode the following unsigned number: **2^{42} ?**
7. Determine the minimum number of bits required to encode the following signed number: **-2^{42}?**
8. Determine the minimum number of bits required to encode the following signed number: **2^{42} ?**

9. How many bytes does the value **1 Mib** contain? Use a power-of-two notation.
10. How many bits does the value **256 KiB** contain? Use binary prefixes (Ki, Mi or Gi) and choose the most appropriate prefix so that the integer numerical value will be as small as possible.

Exercise 2 (7 points)

1. Convert the numbers given on the answer sheet into their **single-precision** IEEE-754 representations. Write down the final result in its **binary form** and specify the three fields.
2. Convert the **double-precision** IEEE-754 words given on the answer sheet into their associated representations. If a representation is a number, use the base-10 following form: $k \times 2^n$ where k and n are integers (either positive or negative).

Exercise 3 (3 points)

For each question in this exercise, choose only one correct answer from these five:

- The output is always 0.
- The output is always 1.
- The output never changes.
- The output toggles on each negative edge of the clock signal.
- We do not know.

Let us consider a master-slave JK flip-flop:

1. How does the output behave if J = K = 1?
2. How does the output behave if J = 1 et K = Q?
3. How does the output behave if J = $\overline{Q}$ et K = Q?

Exercise 4 (5 points)

Complete the timing diagrams shown on the answer sheet (up to the last vertical dotted line) for the following circuits.

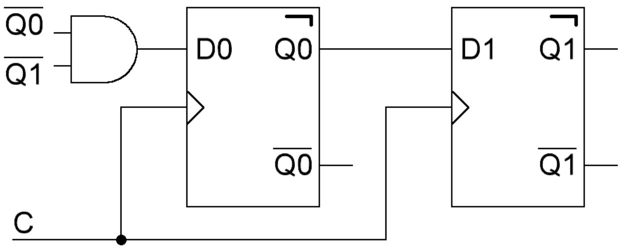

Figure 1

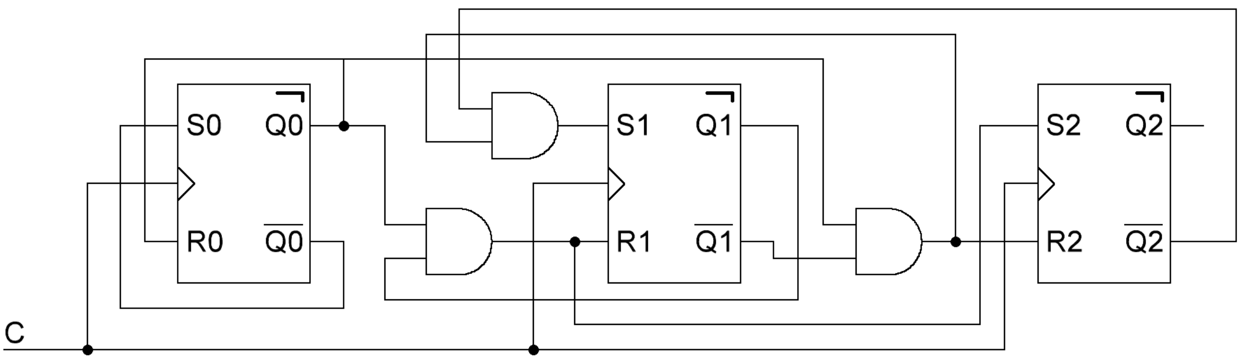

Figure 2

Last name: .... First name: .... Group: ....

ANSWER SHEET

Exercise 1

1. $25A_{16}$	6. 43 bits
2. 602_{10}	7. 43 bits
3. -422_{10}	8. 44 bits
4. $1000\ 0000_2$	9. 2^{17} octets
5. $1000\ 0000_2$	10. 2 Mib

Exercise 2

1.

Number	S	E	M
-88	1	10000101	01100000000000000000000
45.375	0	10000100	01101011000000000000000
0.375	0	01111101	10000000000000000000000

2.

IEEE-754 Representation	Associated Representation
4321000000000000_{16}	17×2^{47}
$FFFFFFFFFFFFFFFF_{16}$	NaN
$7FF0000000000000_{16}$	$+\infty$
8002400000000000_{16}	-9×2^{-1028}

Exercise 3

1. The output toggles on each negative edge of the clock signal.
2. The output toggles on each negative edge of the clock signal.
3. The output toggles on each negative edge of the clock signal.

Exercise 4

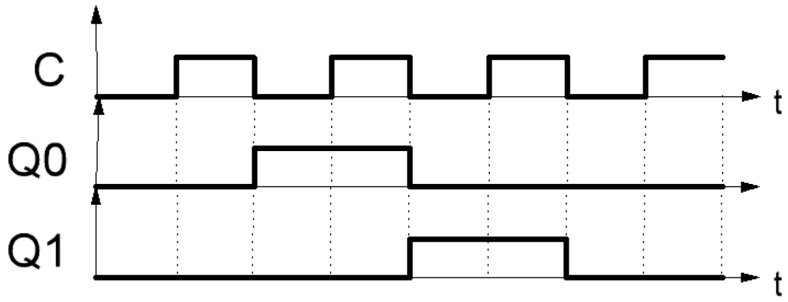

Figure 1

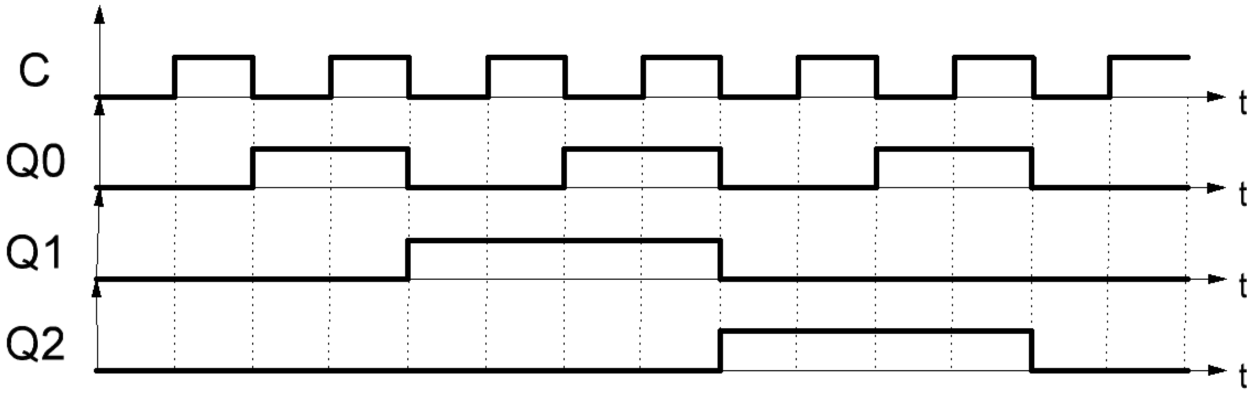

Figure 2

Feel free to use the blank space below if you need to: