Key to Final 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 a pencil or red ink.

Exercise 1 (5 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 2 (5 points)

Answer the questions on the answer sheet.

Exercise 3 (6 points)

The table shown on the answer sheet gives the sequence of a counter we want to design. This counter should be made up of JK flip-flops.

1. Complete the table shown on the answer sheet.
2. Write down the most simplified expressions of J and K for each flip-flop on the answer sheet. **Complete the Karnaugh maps for the solutions that are not obvious**. An obvious solution does not have any logical operations apart from the complement (for instance: J0 = 1, K1 = $\overline{Q2}$).

Exercise 4 (2 points)

The table shown on the answer sheet gives the sequence of a counter we want to design. This counter should be made up of D flip-flops.

1. Complete the table shown on the answer sheet.
2. Write down the most simplified expressions of D for each flip-flop on the answer sheet. **Complete the Karnaugh maps for the solutions that are not obvious**. An obvious solution does not have any logical operations apart from the complement (for instance: D0 = 1, D1 = $\overline{Q0}$).

Exercise 5 (2 points)

What are the two circuits below? Answer on the answer sheet.

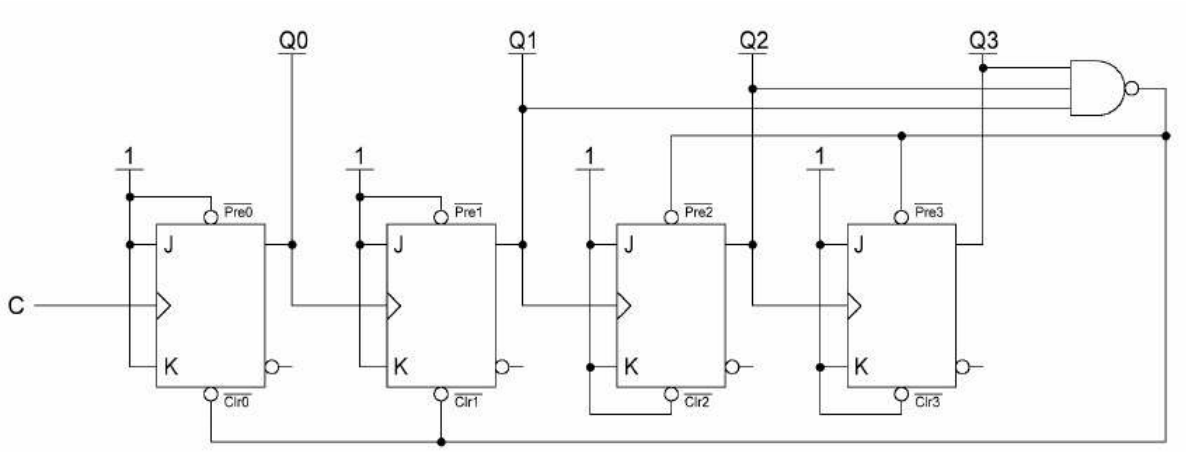

Figure 1

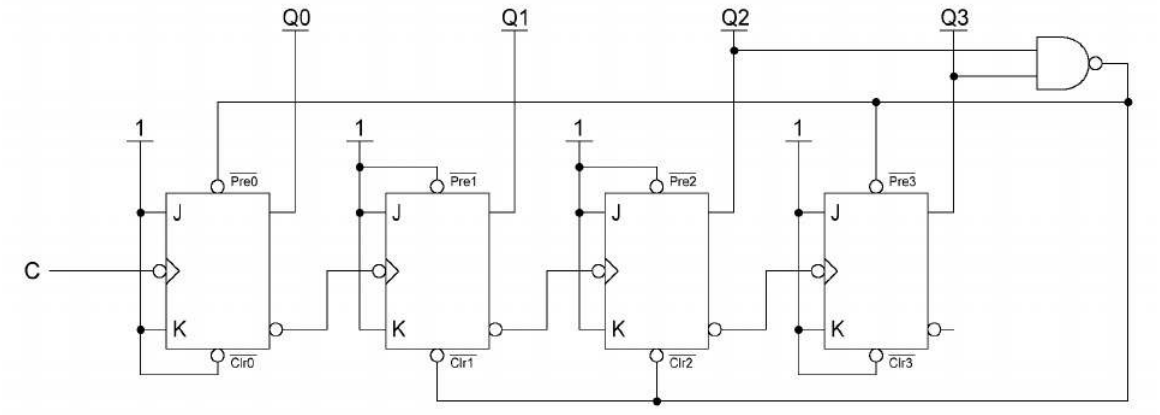

Figure 2

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

ANSWER SHEET

Exercise 1

1.

Number	S	E	M
19.03125	0	10000011	00110000100000000000000
69×2^{-101}	0	00100000	00010100000000000000000

2.

IEEE-754 Representation	Associated Representation
4332000000000000_{16}	9×2^{49}
2360000000000000_{16}	2^{-457}
$00EE000000000000_{16}$	15×2^{-1012}

Exercise 2

Question	Answer
A memory has a depth of 32 Ki words. How many address lines does this memory have?	15 lines
A memory has a 16-bit data bus and a 16-bit address bus. In a power of two, what is the capacity in bits of this memory?	2^{20} bits
An **M1** memory has an 8-bit data bus and a 16-bit address bus. Two **M1** memories are connected in series to build an **M2** memory. What is the size of the address bus of the **M2** memory?	17 bits
A microprocessor has a 24-bit address bus. Five address lines are used for selecting the devices. With the block address decoding, what is the maximum number of address lines that a device connected to this microprocessor can have?	19 lines
A microprocessor has a 20-bit address bus. Using the linear address decoding, we connect this microprocessor to the following devices. • a ROM device (15 address lines) • a RAM device (12 address lines) • a peripheral device (10 address lines) How many address lines are unused in the case of the RAM device?	5 lines

Exercise 3

Q2	Q1	Q0	J2	K2	J1	K1	J0	K0
0	0	0	0	Φ	1	Φ	0	Φ
0	1	0	1	Φ	Φ	1	0	Φ
1	0	0	Φ	0	1	Φ	0	Φ
1	1	0	Φ	1	Φ	1	1	Φ
0	0	1	0	Φ	1	Φ	Φ	0
0	1	1	1	Φ	Φ	1	Φ	0
1	0	1	Φ	0	1	Φ	Φ	0
1	1	1	Φ	1	Φ	1	Φ	1

Do not use Karnaugh maps for obvious solutions.

	Q1 Q0			
J0	**00**	**01**	**11**	**10**
Q2 0	0	Φ	Φ	0
Q2 1	0	Φ	Φ	1

J0 = Q2.Q1

	Q1 Q0			
K0	**00**	**01**	**11**	**10**
Q2 0	Φ	0	0	Φ
Q2 1	Φ	0	1	Φ

K0 = Q2.Q1

	Q1 Q0			
J1	**00**	**01**	**11**	**10**
Q2 0				
Q2 1				

J1 = 1

	Q1 Q0			
K1	**00**	**01**	**11**	**10**
Q2 0				
Q2 1				

K1 = 1

	Q1 Q0			
J2	**00**	**01**	**11**	**10**
Q2 0				
Q2 1				

J2 = Q1

	Q1 Q0			
K2	**00**	**01**	**11**	**10**
Q2 0				
Q2 1				

K2 = Q1

Exercise 4

Q1	Q0	D1	D0
0	0	1	1
1	1	0	1
0	1	1	0
1	0	0	0

Do not use Karnaugh maps for obvious solutions.

Q1 \ Q0	0	1
0	1	0
1	0	1

D0 = $\overline{Q1}.\overline{Q0}$ + Q1.Q0
D0 = $\overline{Q1 \oplus Q0}$

Q1 \ Q0	0	1
0		
1		

D1 = $\overline{Q1}$

Exercise 5

Figure 1 :

Modulo-13 asynchronous down counter

Figure 2 :

Modulo-10 asynchronous down counter

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