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 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 following base-10 form: $k \times 2^n$ where k and n are integers (either positive or negative).

Exercise 2 (4 points)

We want to build a 2-Mib ROM device (labelled ***M***) from several 16-Kib ROM devices (labelled ***m***). The ***M*** device has a 16-bit data bus. The ***m*** devices have a 4-bit data bus. Answer the questions on the answer sheet.

Exercise 3 (5 points)

1. Wire the flip-flops (figure 1) in order to design a **modulo-11 asynchronous up counter**.
2. Wire the flip-flops (figure 2) in order to design a **modulo-11 asynchronous down counter**.
3. Wire the flip-flops (figure 3) in order to design a **shift register (E → Q0 → Q1 → Q2 → Q3)**.

Exercise 4 (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 = $\overline{Q2}$).

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

ANSWER SHEET

Exercise 1

1.

Number	S	E	M
75.75	0	10000101	00101111000000000000000
0.46875	0	01111101	11100000000000000000000

2.

IEEE-754 Representation	Associated Representation
$20A1\ 8000\ 0000\ 0000_{16}$	35×2^{-506}
$7FF7\ 0000\ 0000\ 0000_{16}$	NaN
$0004\ 2000\ 0000\ 0000_{16}$	$33 \times 2^{-1,029}$

Exercise 2

Question	Answer
What is the depth of the ***m*** memory?	**2^{12} words**
What is the depth of the ***M*** memory?	**2^{17} words**
What is the number of address lines of the ***m*** memory?	**12 lines**
What is the number of address lines of the ***M*** memory?	**17 lines**
How many memory devices should be put in parallel?	**4 memory devices**
How many memory devices should be put in series?	**32 memory devices**
How many address lines are required to control the *CS* input of the memory devices?	**5 address lines**
When the ***M*** memory is active, how many ***m*** memory devices are active simultaneously?	**4 *m* memory devices**

Exercise 3

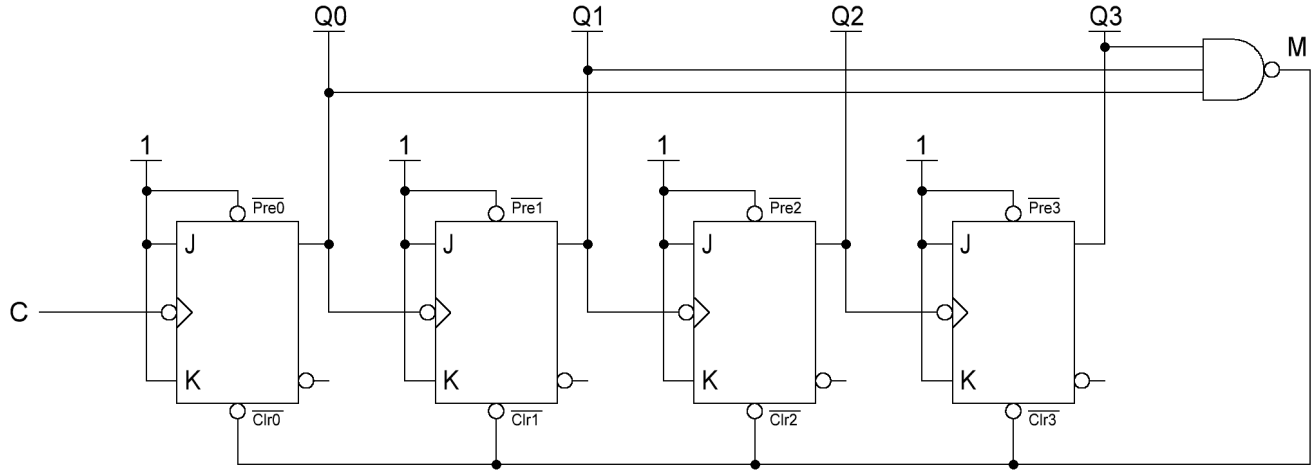

Figure 1

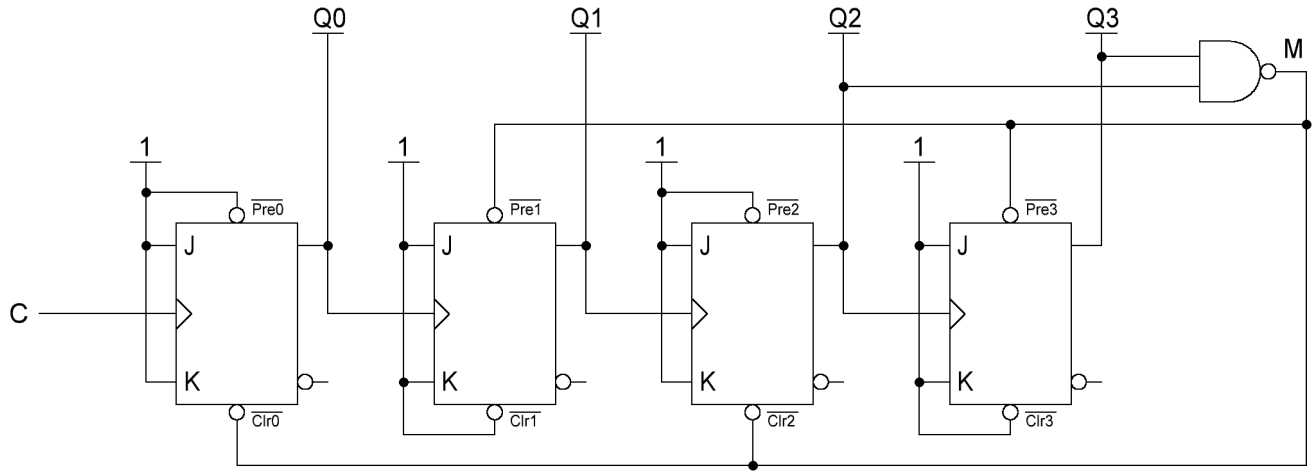

Figure 2

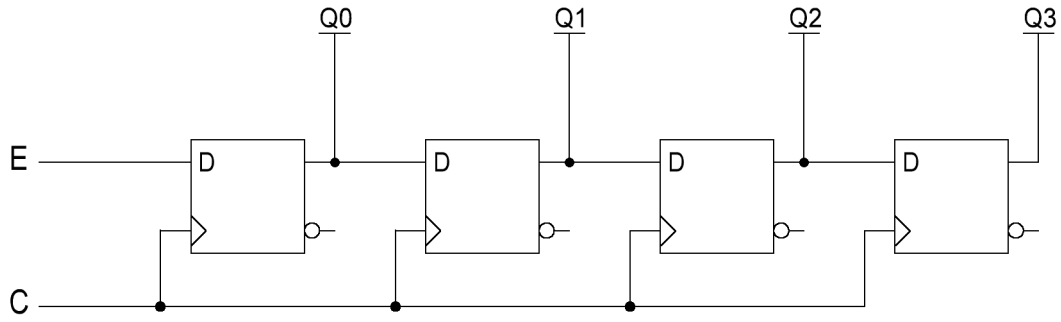

Figure 3

Exercise 4

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

Do not use Karnaugh maps for obvious solutions.

Q1 Q0

J0 / Q2	00	01	11	10
0	1	Φ	Φ	0
1	0	Φ	Φ	1

J0 = $\overline{Q1}.\overline{Q2} + Q1.Q2 = \overline{Q1 \oplus Q2}$

Q1 Q0

K0 / Q2	00	01	11	10
0	Φ	0	1	Φ
1	Φ	1	0	Φ

K0 = $\overline{Q1}.Q2 + Q1.\overline{Q2} = Q1 \oplus Q2$

Q1 Q0

J1 / Q2	00	01	11	10
0	0	1	Φ	Φ
1	0	0	Φ	Φ

J1 = $Q0.\overline{Q2}$

Q1 Q0

K1 / Q2	00	01	11	10
0	Φ	Φ	0	0
1	Φ	Φ	1	0

K1 = Q0.Q2

Q1 Q0

J2 / Q2	00	01	11	10
0	0	0	0	1
1	Φ	Φ	Φ	Φ

J2 = $\overline{Q0}.Q1$

Q1 Q0

K2 / Q2	00	01	11	10
0	Φ	Φ	Φ	Φ
1	1	0	0	0

K2 = $\overline{Q0}.\overline{Q1}$

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