S2 – Examination B3
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 (7 points)

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

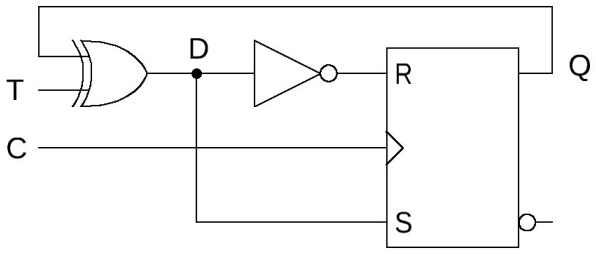


Figure 1

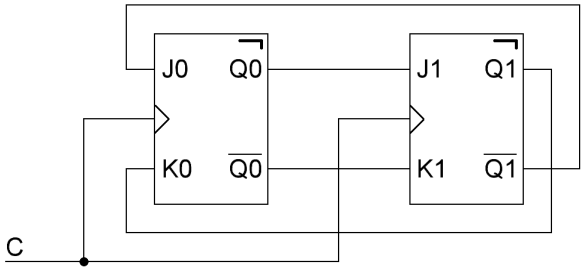


Figure 2

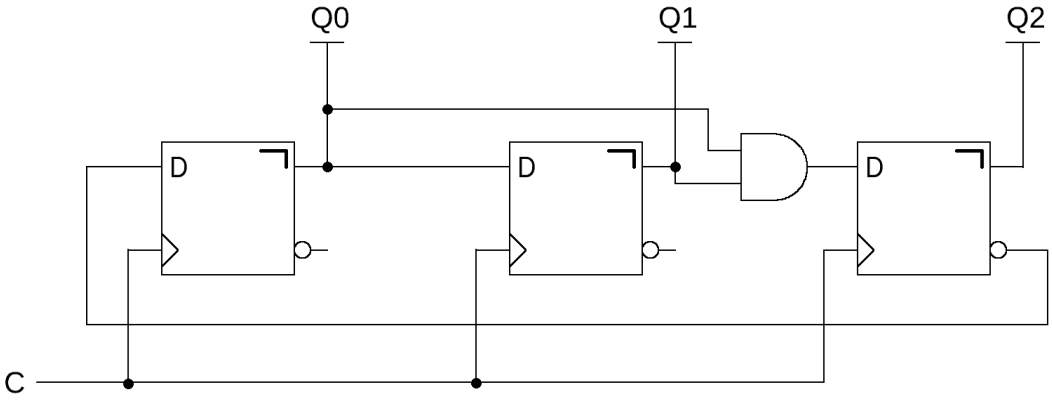


Figure 3

Exercise 2 (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 (circles included) 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 = $\overline{Q2}$). **Do not use the EXCLUSIVE OR operator. No points will be given to an expression if its Karnaugh map is wrong (wrong values or wrong circles or no circles).**

Exercise 3 (4 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. **Complete the Karnaugh maps for the solutions that are not obvious (circles included)**. An obvious solution does not have any logical operations apart from the complement (for instance: D0 = 1, D1 = $\overline{Q0}$). **Do not use the EXCLUSIVE OR operator. No points will be given to an expression if its Karnaugh map is wrong (wrong values or wrong circles or no circles).**

Exercise 4 (3 points)

1. What is the circuit below (figure 4) ? Give the three following features:
   - Up or down counter.
   - Synchronous or asynchronous.
   - Value of the modulo.

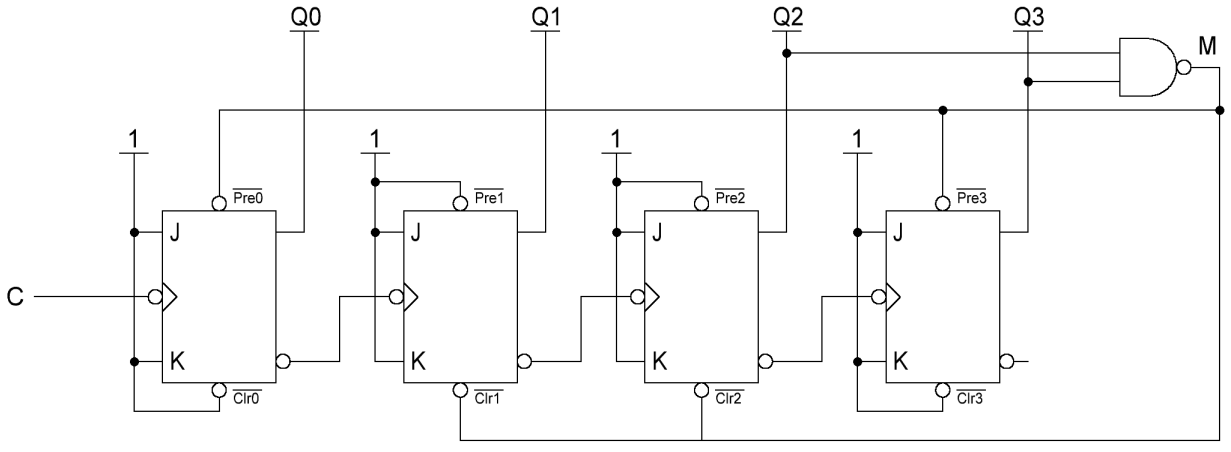


Figure 4

2. Wire the flip-flops (figure 5) in order to design a **modulo-13 asynchronous down counter**.

Family name: ..... First name: ..... Group: .....

ANSWER SHEET

Exercise 1

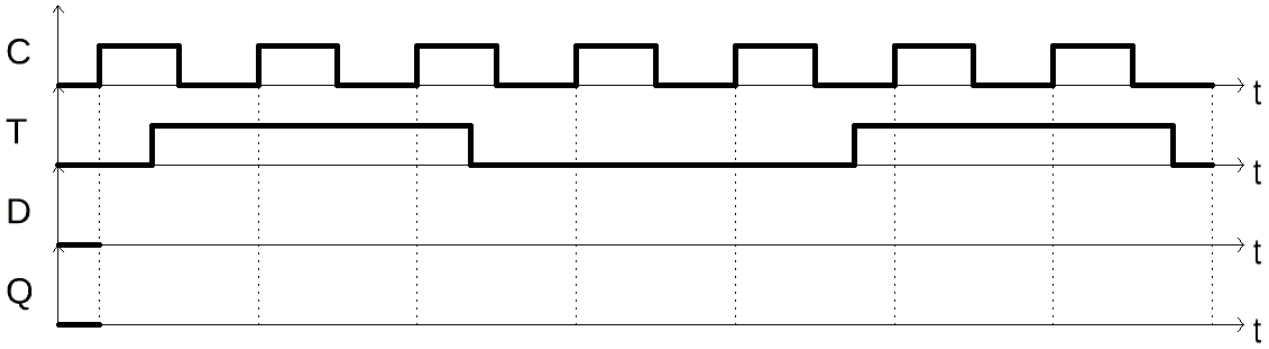


Figure 1

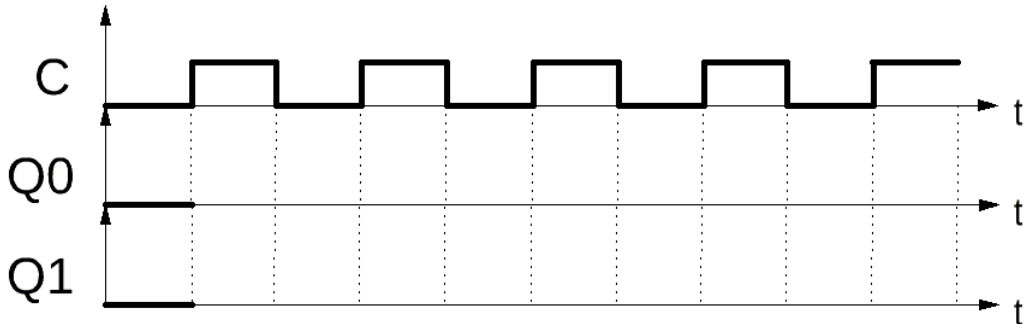


Figure 2

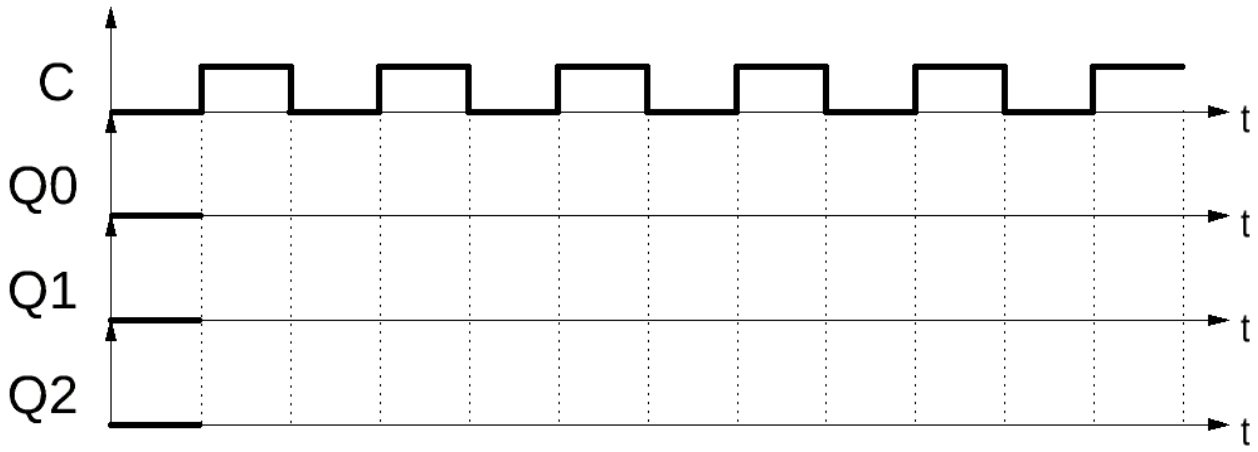


Figure 3

Exercise 2

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

Do not use Karnaugh maps for obvious solutions.

Q1 Q0

J0 / Q2	00	01	11	10
0				
1				

J0 =

Q1 Q0

K0 / Q2	00	01	11	10
0				
1				

K0 =

Q1 Q0

J1 / Q2	00	01	11	10
0				
1				

J1 =

Q1 Q0

K1 / Q2	00	01	11	10
0				
1				

K1 =

Q1 Q0

J2 / Q2	00	01	11	10
0				
1				

J2 =

Q1 Q0

K2 / Q2	00	01	11	10
0				
1				

K2 =

Exercise 3

1.

Q2	Q1	Q0	D2	D1	D0
1	1	1			
1	0	1			
1	0	0			
1	1	0			
0	1	0			
0	1	1			
0	0	1			

2.

		Q1 Q0			
	D0	00	01	11	10
Q2	0				
	1				

D0 =

		Q1 Q0			
	D1	00	01	11	10
Q2	0				
	1				

D1 =

		Q1 Q0			
	D2	00	01	11	10
Q2	0				
	1				

D2 =

Exercise 4

1. Figure 4 :

2.

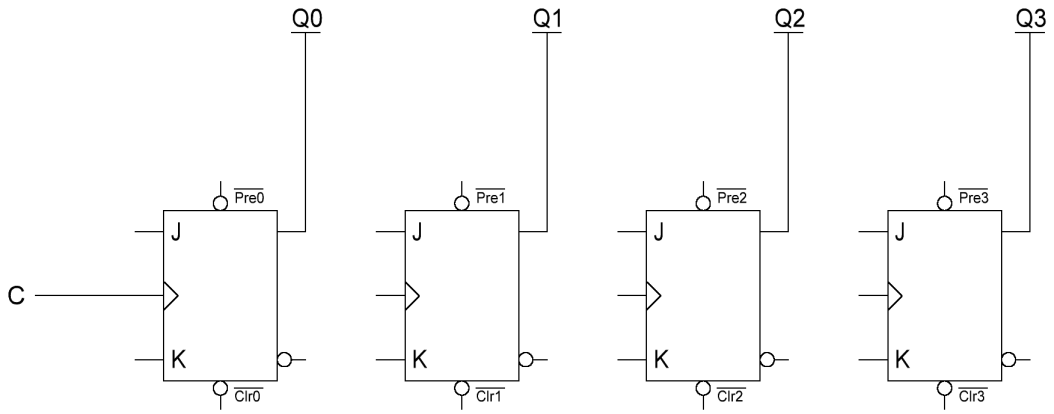


Figure 5

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