Key to B3 Examination
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)

1. Complete the timing diagrams shown on the answer sheet (up to the last vertical dotted line) for the circuits in figures 1 and 2.
2. Complete the truth table on the answer sheet for figure 3.

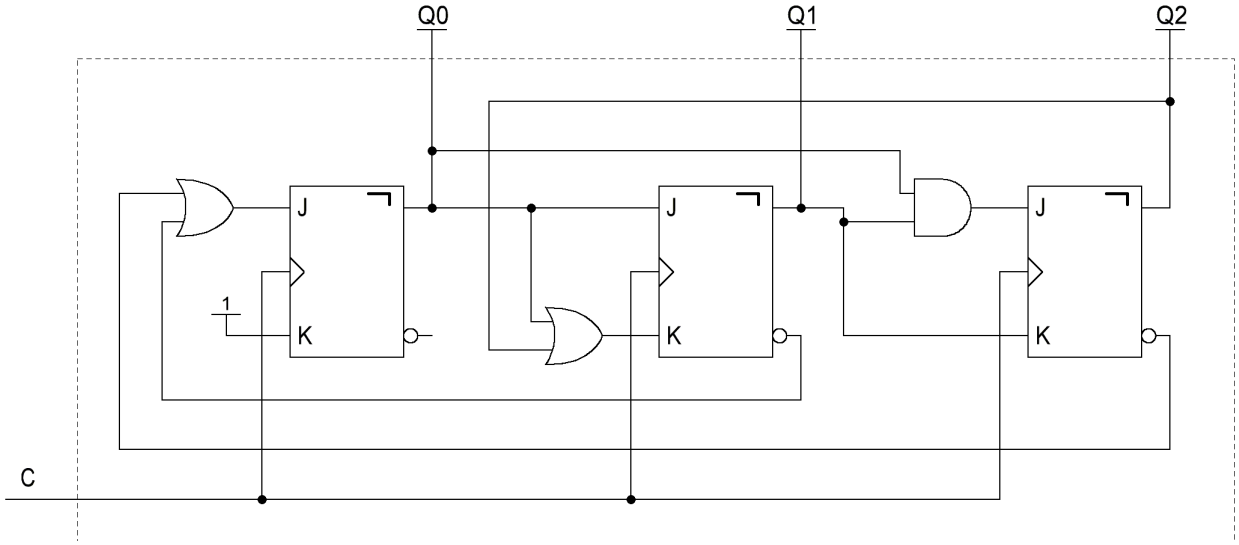


Figure 1

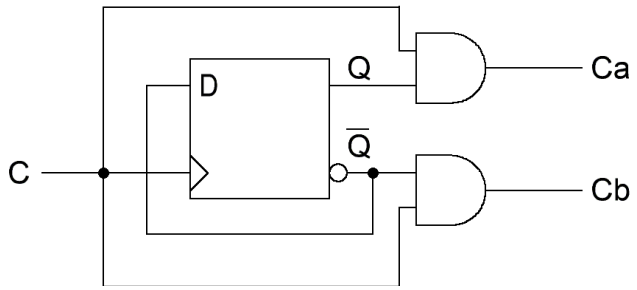


Figure 2

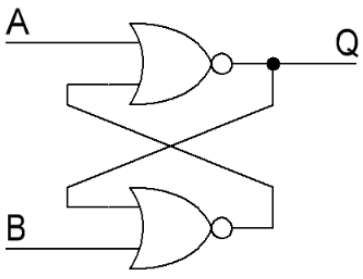


Figure 3

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.

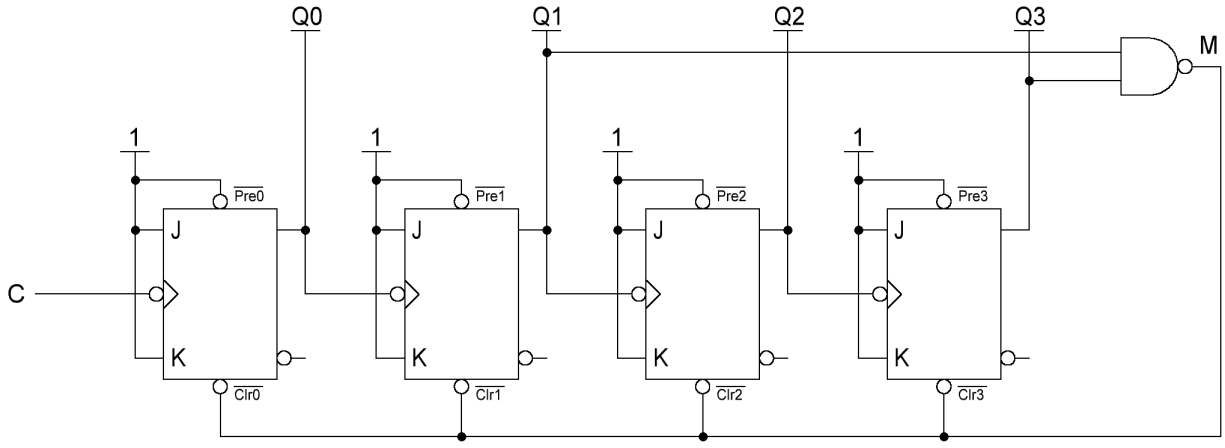


Figure 4

2. Wire the flip-flops (figure 5) in order to design a **modulo-15 asynchronous down counter**.

Family Name ..... First Name ..... Class.....UID.....

ANSWER SHEET

Exercise 1

1.

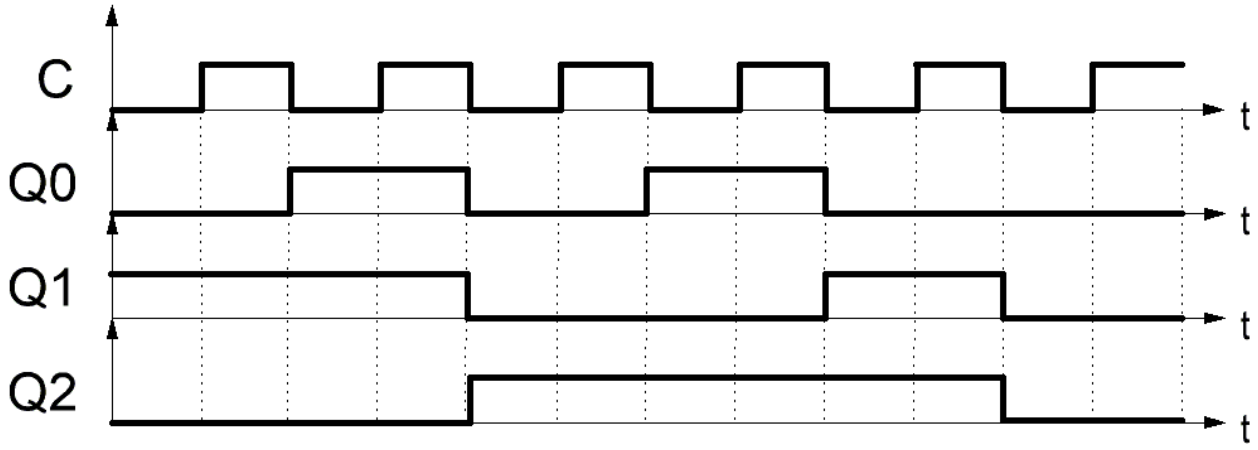


Figure 1

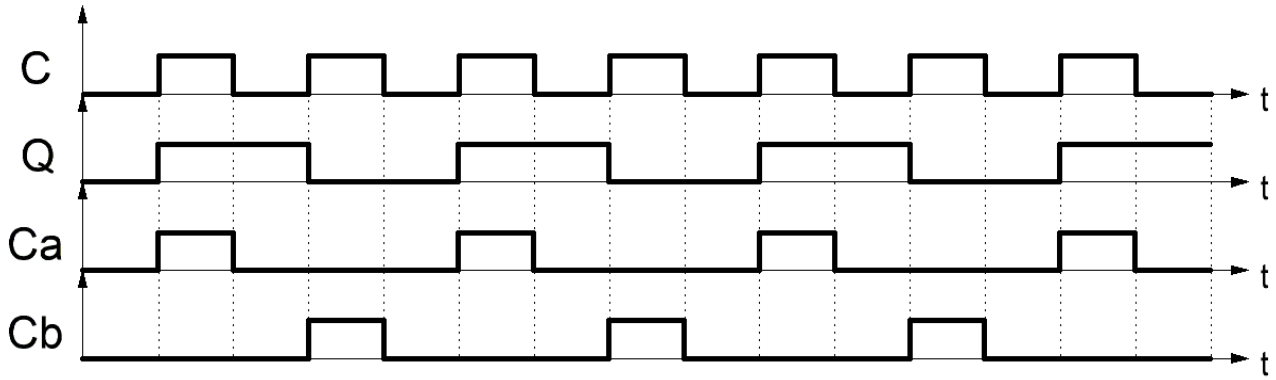


Figure 2

2.

A	B	Q
0	0	q
0	1	1
1	0	0
1	1	0

Figure 3

Exercise 2

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

J0 \ Q2 \ Q1 Q0	00	01	11	10
0				
1				

J0 = 1 (or also $\overline{Q0}$)

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

K0 = Q2 + $\overline{Q1}$

J1 \ Q2 \ Q1 Q0	00	01	11	10
0	1	0	Φ	Φ
1	0	1	Φ	Φ

J1 = $\overline{Q2}$. $\overline{Q0}$ + Q2.Q0

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

K1 = Q0

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

J2 = $\overline{Q0}$

K2 \ Q2 \ Q1 Q0	00	01	11	10
0	Φ	Φ	Φ	Φ
1	0	0	0	1

K2 = Q1.$\overline{Q0}$

Exercise 3

1.

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

2.

	Q1 Q0			
D0	**00**	**01**	**11**	**10**
Q2 0	1	0	1	Φ
Q2 1	1	0	0	1

D0 = $\overline{Q0}$ + $\overline{Q2}$.Q1

	Q1 Q0			
D1	**00**	**01**	**11**	**10**
Q2 0	1	0	0	Φ
Q2 1	0	1	0	1

D1 = $\overline{Q2}$.$\overline{Q0}$ + Q1.$\overline{Q0}$ + Q2.$\overline{Q1}$.Q0

	Q1 Q0			
D2	**00**	**01**	**11**	**10**
Q2 0	1	0	0	Φ
Q2 1	1	1	1	0

D2 = $\overline{Q1}$.$\overline{Q0}$ + Q2.Q0

Exercise 4

1. Figure 4 :

Modulo-10 asynchronous up counter

2.

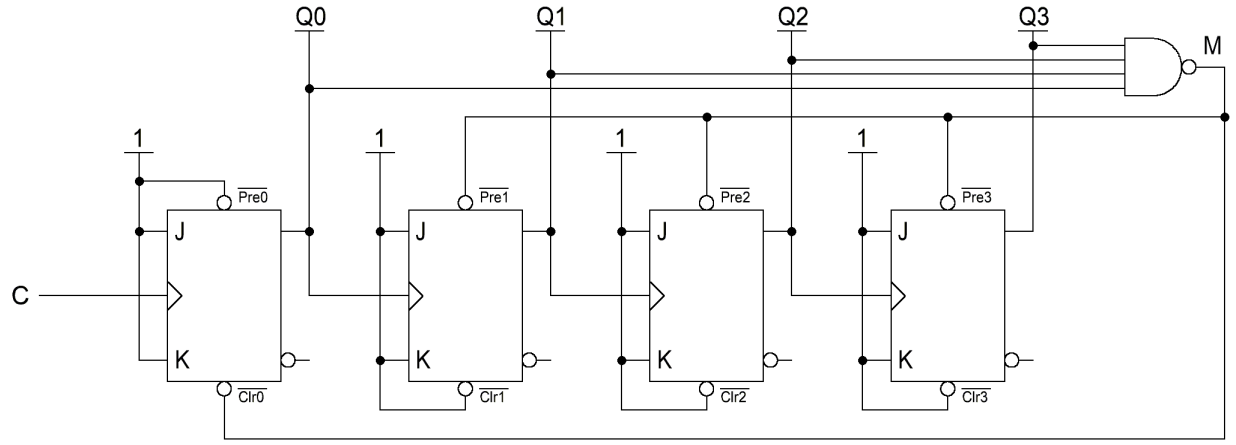


Figure 5

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