|  |  |
| --- | --- |
| **Digital circuits laboratory class** | **Year 2024, exercise 1** |
| Author: Jakub Turkowski | Title of the exercise: introducing the problems of the laboratory |
| Laboratory group number: 2 | Week day: Tuesday  Realization date: 13.03.2024  Hours of the lab: 15:15-16:55 |

**Circuit a)**

The circuit needs a high input to clear, which in this case will also result in a high input for D and S1. This means that as long as S0 will be low a shift to the left will occur. Else, the outputs will remain at their starting positions.

**Circuit b)**

As the input S0 is grounded it will always be in the low state, so there is no way for the output series to shift to the right. S1 on the other hand is connected to the CLR, which means that as long as the state of that input is not low (for which the outputs would all be low as well) and the clock is transitioning from low to high (if it was low the outputs wouldn’t be affected) the shift will occur to the left. This means that we don’t have to pay attention to the right input and the outputs will be:

Qa=Qbn, Qb=Qcn, Qc=Qdn

Where bn, cn and dn stand for the values before the most recent transition of the clock. And then depending on their values Qd will be equal to the state of left input, which is dependent on an a NAND gate. So if:

Qdn=Qcn=Qbn=1

Then:

Qd=0

And in any other case:

Qd=1

**Circuit c)**

As the input S0 is grounded it will always be in the low state, so there is no way for the output series to shift to the right. As long as long as the state of S1 is high not and the clock is transitioning from low to high the shift will occur to the left. This means that we don’t have to pay attention to the right input and the outputs will be:

Qa=Qbn, Qb=Qcn, Qc=Qdn

Where bn, cn and dn stand for the values before the most recent transition of the clock. And then the value of Qd will be equal to the state of left input, which is dependent on the state of Qa, which goes through the NOT gate . So:

If Qa =1 then Qd=0

If Qd=0 then Qd=1