



Digital Systems Wintersemester 2017/2018

Serie 9

Issue Date: Monday, 22.01.2018

Submission Date: Wednesday, 31.01.2018

Presentation tasks

Task 1

Design an asynchronous Modulo-7-Counter. The counter shall be built using J-K- flip flops. Give the circuit as well as the necessary design steps / clarifications.

Homework

Task 1 - Short questions

- What is the optimal time complexity for a carry select addition of n numbers being divided in m parts of equal size?
- What does the method of Quine do?

$2^{1/2}$, $2^{1/2}$ points

Task 2

To open the door of an electrical safe a code has to be entered. It reads $2 - 7 - 2 - 0$. The numbers are entered one by one. The user may press arbitrary keys (0..9) on the keypad; on an erroneous input, a warning signal W should be given ($W = 0$: no erroneous input; $W = 1$: erroneous input). On entering the next digit, the signal W is set to 1 or 0 again, depending on the former correctness of the current input(including the new digit). When the code $2 - 7 - 2 - 0$ is entered completely in the right order, the lock should be opened by setting the signal $O = 1$ (O for open). Note that there may be digits which when entered make the current input erroneous but which also belong to the correct code. This correct code needs to be recognized, too. Additionally, the signal W needs to be set to 1 on entering the digit which makes the current input erroneous. After that, processing may continue, considering the past input. The door closes and locks itself automatically after use, until a correct code unlocks it again. Design a sequential circuit for controlling the lock:

- Identify the inputs and outputs of the automaton. Develop a wise coding for the inputs (the digits of the keypad) to keep the expense small. If a combinational circuit is needed for the coding, also state it (with drawing).
- Draw the complete automaton graph.

10, 20 points

