University Bremerhaven

INSTITUTE FOR AUTOMATION AND ELECTRIAL ENG.

Prof. Dr.-Ing. Kai Mueller

Sample Test PS-DIGS W14/15-1

Time 90 minutes
– use of class documents allowed –

Name: _____ **Percent:** _____

Matr. No.: _____ **Grade:** _____

1	2	3	4		Σ

(1) Conversion of Number Systems and Dual Number Computation

Computation with signed dual number should be carried out. The word size should be 16 bits. The number $x = 348_{10}$ is given as a decimal number.

(1.1) What is the minimal (negative) number with 16 bits? Whta is the maximum positive number?
Hint: signed number have a 2's complement representation.
Your results should be given as decimal numbers.

(1.2) Convert the number x into the dual system by sequential division and remainders

(1.3) Wht is the binary number of $-x$ (2's complement, 16 bits!)?

(1.4) Provide the hexadecimal numbers of x und $-x$?

(2) Combinational Logic (Minimization)

The following truth table should be synthesized as combinational gate logic.

(1) = 8 (2) = 8 (3) = 8 (4) = 8 Σ = 32

1.0 ≥ 29 1.3 ≥ 27 1.7 ≥ 26 2.0 ≥ 24 2.3 ≥ 23 2.7 ≥ 21 3.0 ≥ 20 3.3 ≥ 18 3.7 ≥ 17 4.0 ≥ 15

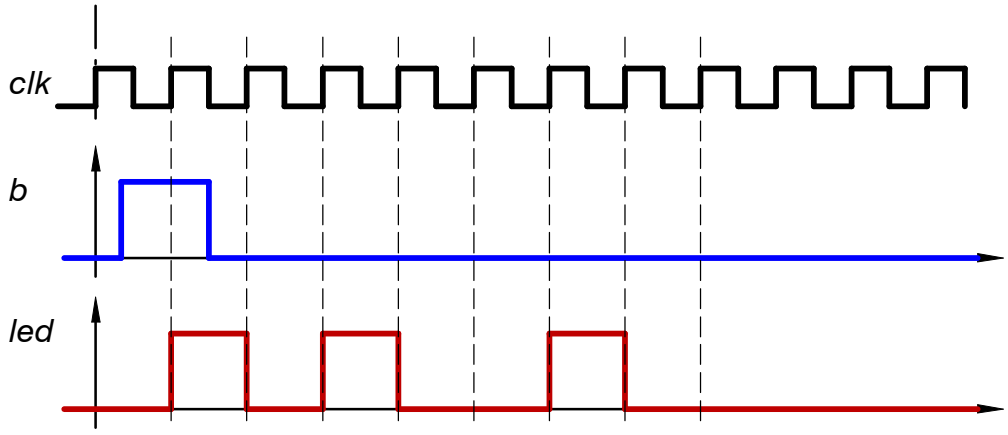
x3	x2	x1	x0	y1	y0
0	0	0	0	1	0
0	0	0	1	1	0
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	1	0
0	1	0	1	1	0
0	1	1	0	0	0
0	1	1	1	1	0
1	0	0	0	1	1
1	0	0	1	1	0
1	0	1	0	0	1
1	0	1	1	1	0
1	1	0	0	1	1
1	1	0	1	1	0
1	1	1	0	1	1
1	1	1	1	1	0

(2.1) Find a minimal solution for the dunction $y_0 = F_0(x_0, x_1, x_2, x_3)$ as *product of sums*. Draw the circuit with inverters, AND and OR gates.

(2.2) Find a minimal solution for the dunction $y_1 = F_1(x_0, x_1, x_2, x_3)$ as *sum of products*.
Draw the circuit with inverters, AND and OR gates.

(3) Hardware State Machine (Moore Machine)

A hardware state machine should be designed to flash an LED several times after a button has beed activated. It should stop after 6 clock cycles. All activities are aligned with the rising edge of the clock signal.



Input of the state machine:

b '1' => generate sequences below, '0' => off.

Output of the state machine:

led '1' => on, '0' => off

(3.1) Draw the state diagram.

(3.2) How many states are required; how many flip-flops are required?

(3.3) Design the minimal solution only for x_{0n} for the next-state logic (including circuit schematics).

(3.4) Design minimal solution for the output logic.

(3.5) Draw the flip-flops and output logic hardware circuit.

(4) PicoBlaze Program "Moving Lights"

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--- lab (moving light) must be attached to the exam solutions ---
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Hints:      Your program must contain name and matriculation number
            The programm should contain comments.
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