

Final exam DITE: Monday, January 15, 2018 -- 14:00 to 17:00h

Task I (4 points): Perform the following 3 calculations:

A) Convert the BCD number $(0010\ 0101)_{BCD}$ into a binary number;

B) Do the following arithmetic operation in the binary number system **by using the signed-1's complement representation** of the numbers:

$$\begin{array}{r} (-28) \\ - \\ (+36) \\ \hline \end{array}$$

C) Do the following **unsigned** binary subtraction **by 2's complement addition**:

$$\begin{array}{r} 25 \\ - \\ 40 \\ \hline \end{array}$$

Important: Show and explain step-by-step how you perform the calculations.

Task II (5 points): Simplify the Boolean function $F(w,x,y,z) = \sum m(1,5,6,7,11,12,13,15)$ by finding all prime implicants and essential prime implicants and applying the selection rule. After you have simplified the function, represent it using the **logic basis NOR**. Also, draw the combinational logic circuit corresponding to the function **using only 2-input NOR gates**.

Important: Show all prime implicants and essential prime implicants as well as explain all the steps you do to simplify and represent function $F(w,x,y,z)$.

Task III (5 points): Implement a binary Full Adder using a single 4-to-1 2-line Multiplexer and a single XOR gate.

Important: Show and explain all the steps you do to implement the Full Adder.

Task IV (6 points): A sequential circuit with two flip-flops A and B, one input X, and one output Z is specified by the following equations:

$$A(t+1) = X(t)'A(t) + X(t)B(t)$$

$$B(t+1) = X(t)'A(t)'$$

$$Z(t) = X(t)A(t) + X(t)'B(t)'$$

Transform and implement the circuit described above as **Moore Finite State Machine (FSM)** under the following conditions:

1. Use **only** NAND gates and T Flip-Flops;
2. Derive and show the state table of **the Moore FSM**;
3. Derive and show the state diagram of **the Moore FSM**;
4. Draw the logic diagram of **the Moore FSM**.

Important: Show and explain all the steps you do to implement the circuit above.

The exam grade is equal to the obtained number of points divided by 2!