

Exercise 4: Analysis of synchronous circuit

The synchronous circuit given on Fig. 1a should be converted to the form in which only NAND gates are used (There is no AND nor OR gates on the breadboard. Please check also the number of available NAND gates). The circuit after the conversion must behave exactly as the given circuit. Additional constraint: You can't use NOT gates nor create NOT gates with NAND gates. Eventually one can use one NOT gate (7402). For simplicity Fig. 1a does not show clock signal and asynchronous inputs of flip-flops.

The steps of the exercise:

1. Assuming that initial state of the circuit is $y_1y_2=00$ check the behavior of the circuit for the following input sequence: ...111100 (signals used to set the input x).
2. Write down the values of output Z as well as of outputs of both flip-flops (to the table 1c).
3. Ask the teacher to verify proper behavior of the circuit.

Content of the report:

- On page 1: analysis of the circuit (excitation functions of flip-flops D_1, D_2 , with state output table. State transition table should be placed on the last page – see Fig. 1b)
- On page 2: synthesis of synchronous circuit with JK flip-flops that behaves exactly as the circuit given on Fig. 1a. The states should be coded in such a way that the resulting circuit will include 1xNOT and 2xAND.
- On the last page please put the circuit from Fig. 1a, circuit to be realized (Fig. 1d), filled table of transitions-outputs (Fig. 1b) and results of experiment of applying the sequence of signals given above (Fig. 1c).
- The print-out of circuits and of their simulation from CAD is optional but increases the grade.

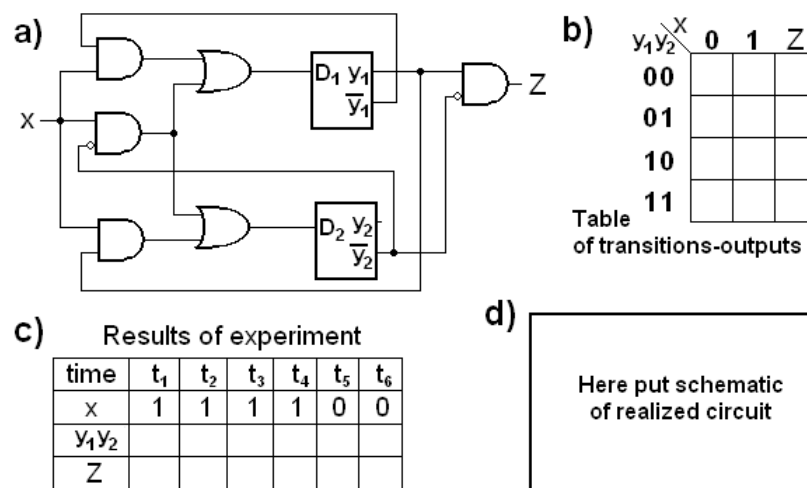


Figure 1

Comments:

1. Please do not forget to connect asynchronous inputs of flip-flops.
2. Please do not use the setter of logical values, when a certain input of the system should always be a constant value (0 or 1). In such case use the available values directly from the breadboard (red wire - value 1, black / blue wire - value 0).
3. Use LED display to show values of Z, y_1 and y_2 .