





## Logic Design – Lab 2

### “Design of sequential circuit with use of consecutive switching tables”

**For the report, please complete the tasks marked in green boxes only!**  
**(ver. 2020)**

#### Main rules

1. On the base of the conditions for a sequential circuit operation the primary consecutive switching table is constructed
2. One has to check whether the primary table contains contradictions or does not contain them. For this purpose:
  - a. For all steps the circuit state (CS) in decimal form is determined
  - b. If the primary table does not contain repeated circuit states (CSs) then this table is directly solvable, otherwise additional element (or elements) is to be included
  - c. For all output elements one marks the steps with conditions for operation (  sign) and for not operation (  sign)
  - d. The primary table is solvable also if the repetitions of the circuit states (CSs) are such that they are present within one type of the conditions, i.e. within the steps marked with only  or only with .
  - e. If the above condition is not satisfied then an additional element (sometimes more than one element is needed) has to be included into the table and solvability of the obtained table has to be inspected.
3. Logic formulae for the output elements and for additional elements (if introduced) have to be determined.
4. Implementation with use of the logic gates or switches has to be accomplished.

**Task 1 – Design of sequential circuit with use of the consecutive switching tables.  
Implementation with use of switches.**

The sequential circuit ( $x$  – one input element,  $y_1, y_2, y_3$  – three output elements) is operating as follows:

$x+$ ,  $y_1+$ ,  $y_2+$ ,  $y_3+$ ,

$y_1-$ ,  $y_2-$ ,  $y_3-$ ,

$y_1+$ , .....

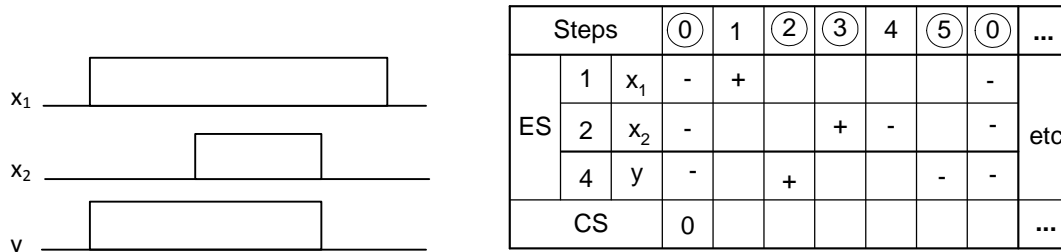
where “+” means switching on, “-“ means switching off.

Steps			0	1	2	3	4	5	6	1	2	...
ES	1	$x$	-	+								
	2	$y_1$	-		+			-			+	
	4	$y_2$	-			+			-			
	8	$y_3$	-				+			-		
CS			0									...

Determine the equations suitable for implementation with switches and verify that above designs work correctly (according to the consecutive switching table as above).

**Task 2a – Design of sequential circuit with use of the consecutive switching tables.  
Implementation with use of logic gates**

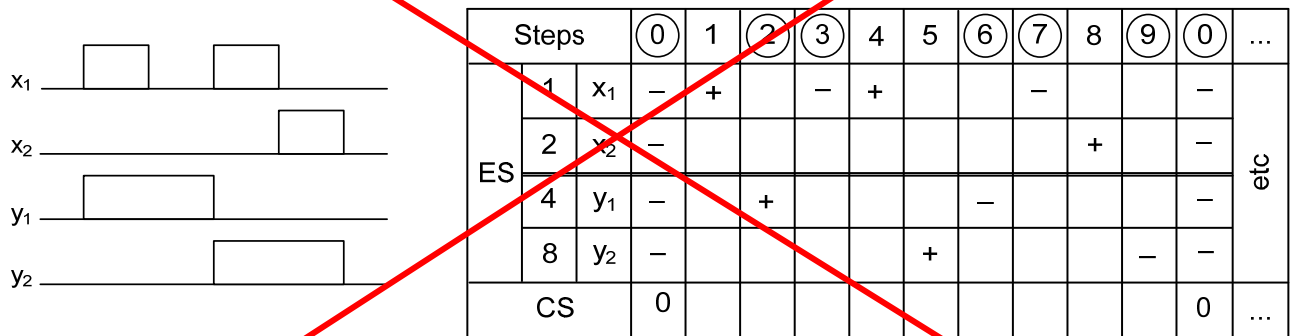
The sequential circuit ( $x_1$ ,  $x_2$  – input elements,  $y$  – output element) is operating as follows:



Determine the equations suitable for implementation with **NAND** gates only and simulate them using Electronic Workbench to verify that above designs work correctly (according to the consecutive switching table as above).

**Task 2b – Design of sequential circuit with use of the consecutive switching tables.  
Implementation with use of logic gates**

The sequential circuit ( $x_1$ ,  $x_2$  – input elements,  $y_1$ ,  $y_2$  – output elements) is operating as follows:



Determine the equations suitable for implementation with **NOR** gates only and simulate them using Electronic Workbench to verify that above designs work correctly (according to the consecutive switching table as above).