

# Laboratory Exercise 9

## Description

In this lab you will design a one-input, two-output sequential circuit that recognizes and distinguishes the occurrence of two specific 4-bit sequences in its input stream, using the same approach described in class.

## Procedure

The circuit has one input,  $x$ , and two outputs,  $z_1$  and  $z_2$ . If the sequence 1100 is applied to the input line  $x$ , the output should become 01 when the last bit appears, and the circuit should return to its reset (initial) state. If a second sequence 0110 is applied to  $x$ , the output should become 10 when the last bit appears, and again the circuit should return to the initial (reset) state. The quiescent output pattern is  $z_1z_2 = 00$ ; that is, when neither of the previous input patterns is detected the circuit outputs 00. Note that either of the previous patterns may be preceded by any patterns that do not include either of them.

Start by determining an appropriate **state diagram**.

**State Diagram:**



Once you have determined a state diagram that uses a minimum number of states, build a **state-transition table**. Use T flip-flops. Show the state-transition table in the box below.

**State-Transition Table:**

Once the state table is complete, obtain minimized expressions for the inputs to each flip flop and implement your circuit. Label the input and outputs of your circuit and use *timing diagrams* to verify the correctness of your circuit.

Note: you should include an additional *asynchronous reset (priority) input* for resetting the *initial* value of the flip flops. Write the minimized expressions below and show your final circuit and lab sheet to the Teaching Assistant.

**Minimized Expressions:**