Name: _____ ID# _____

Date Submitted: _____ Lab Section # _____

CSE 2441 – Introduction to Digital Logic Fall Semester 2014

Lab Number 8 – Finite State Machine Design and Analysis

100 Points

(To be performed October 30-31, 2014)

CSE 2441 **LABORATORY SESSION 8** **FALL 2014**

FINITE STATE MACHINE DESIGN AND ANALYSIS

(100 POINTS)

PURPOSE and OUTCOME: To give you experience designing and analyzing synchronous circuits that use D flip-flops (SN 7474) or JK flip-flops (SN7476) as memory elements to realize finite state machines (FSMs). After completing this lab, you will be able to analyze and design basic finite state machines, capture and verify designs using Quartus II, and construct synchronous circuits on a sorderless breadboard.

BACKGROUND: Synchronous sequential circuits can be modeled by finite state machines (FSMs). Mealy machines are structured as shown below in Figure 1 and are typified by state diagrams like the one in Figure 2.. Moore machines are illustrated in Figures 3 and 4.

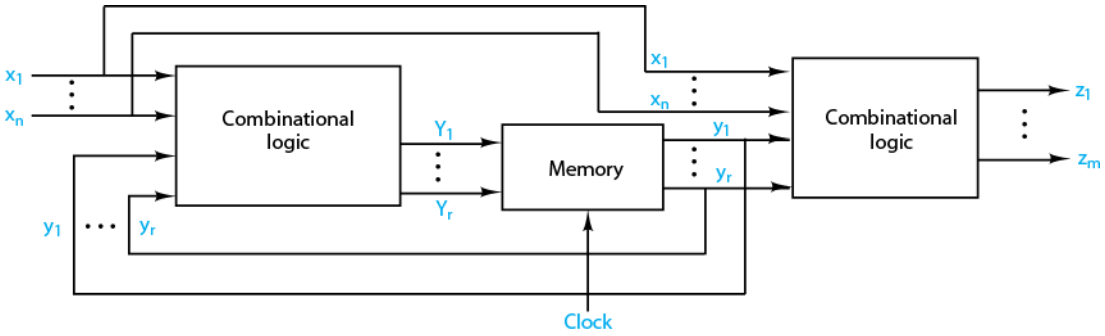


Figure 1. Mealy Machine Structure

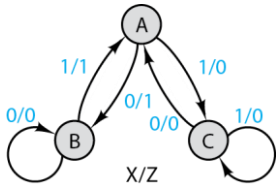


Figure 2. Mealy State Diagram

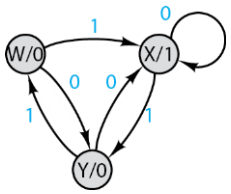


Figure 4. Moore State Diagram

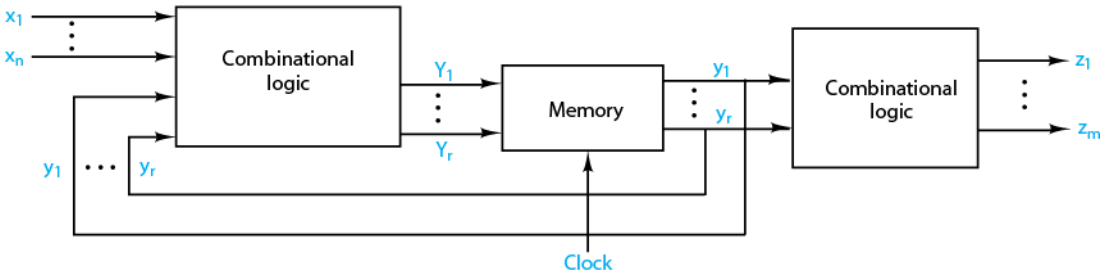
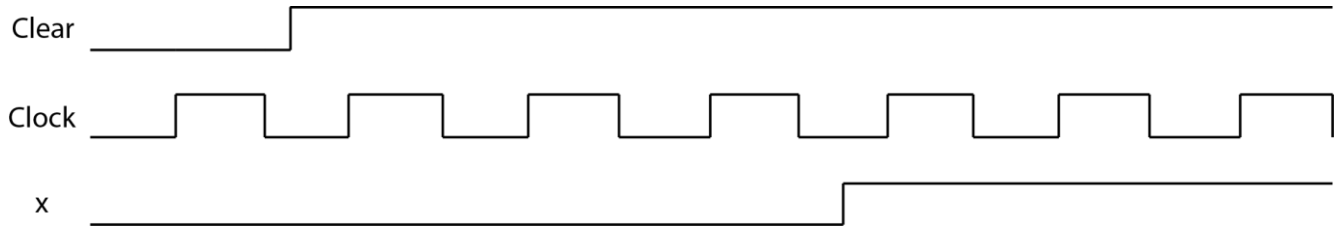


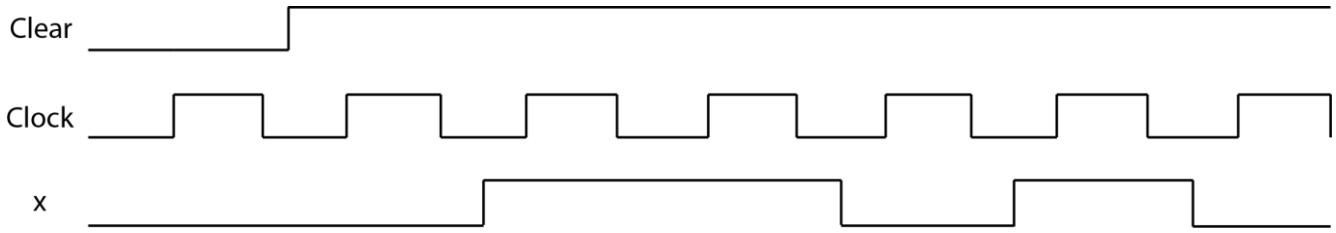
Figure 3. Moore Machine Structure

PRELAB ASSIGNMENT [20 points] – To be completed prior to your lab session.

1. Use Quartus II to capture your design for the FSM specified in Problem 4 of Homework 7 (problem 4.51 from *Nelson, et.al., 2nd edition*). Add an active-low *Clear* input pin and output pins displaying the state variables. Your design should only use ICs from your lab kit.
2. Simulate and record the circuit's response to the following input sequence.



3. Use Quartus II to capture the design of the *Robot Controller* circuit discussed in Class 10.1. Add an active-low *Clear* input pin and state variable output pins as above. Your design should only use ICs from your lab kit.
4. Simulate and record the controller's response to the following.



LAB ASSIGNMENT [80 points] – Use the following pin assignments when constructing your circuits.

$x \rightarrow$ Data Switch SW7	$y_1 \rightarrow$ LED 7
Clock $\rightarrow$ Pulse Switch A	$y_2 \rightarrow$ LED 6
Clear $\rightarrow$ Pulse Switch B	$z_1 \rightarrow$ LED 5
	$z_2 \rightarrow$ LED 4

1. Construct your realization of Problem 4 using ICs from your lab kit.
2. Experimentally derive the state diagram of your circuit. Record in your lab notebook.
3. Experimentally derive your circuit's response to the input sequence given in the PreLab. Record your results. Explain the timing of state and output changes relative the input and clock signals.
4. Have the lab instructor check your work.

5. Construct your realization of the Robot Controller from Class 10.1 using ICs from your lab kit.
6. Experimentally derive the state diagram of your circuit and record your results.
7. Experimentally derive your circuit's response to the input sequence given in the PreLab. Record your results. Explain the timing of state and output changes relative the input and clock signals.
8. Have the lab instructor check your work.