

## COE 405, Term 162

### Design & Modeling of Digital Systems

#### Assignment# 2

Due date: Saturday, March 11

- Q.1.** Consider the given FSM that has 6 states, two inputs X and Y, and one output Z, represented by the following state table:

Present State	Next State				Output
	XY=00	XY=01	XY=10	XY=11	Z
S0	S1	S3	S0	S4	0
S1	S0	S4	S1	S5	0
S2	S2	S5	S0	S5	0
S3	S1	S3	S0	S4	1
S4	S0	S4	S2	S5	1
S5	S1	S3	S1	S3	1

- (i) Determine the equivalent states.
- (ii) Reduce the state table into the minimum number of states and show the reduced state table.
- Q.2.** Consider the given FSM that has 4 states, one input (X) and one output (Z), represented by the following state table:

Present State	Next State, Z	
	X=0	X=1
S0	S0, 1	S2, 0
S1	S0, 0	S2, 0
S2	S1, 0	S3, 0
S3	S1, 0	S3, 1

- (i) Implement the FSM using the following state assignment:  $S_0=00$ ,  $S_1=10$ ,  $S_2=01$ ,  $S_3=11$ .
- (ii) Implement the FSM using the following state assignment:  $S_0=10$ ,  $S_1=01$ ,  $S_2=11$ ,  $S_3=00$ .
- (iii) Compare the area of the two resulting circuits.

**Q.3.** It is required to design a sequential circuit using Mealy model that computes the equation  $Z=3*X-3$ , where  $X$  is an unsigned number that will be fed serially. Assume that the circuit has an asynchronous Reset input that resets the machine to the reset state.

- (i) Draw the state diagram for your sequential circuit. Make sure that your state machine is minimal and that it does not have any redundant state.
- (ii) Derive minimized equations for the output  $Z$  and next state variables.
- (iii) Write a Verilog model for modeling your sequential circuit.
- (iv) Write a Verilog test bench to test the correctness of your design for the following input values:  $\{X=1\}$ ,  $\{X=3\}$ ,  $\{X=5\}$  and  $\{X=4\}$ .

This assignment can be solved based on a group of two students. The solution should be well organized. Submit a soft copy of your solution in a zip file including your Verilog models. Your solution should be submitted in a PDF file that contains the following items:

- i. Your name and ID
- ii. Assignment number
- iii. Problem statement
- iv. Your solution
- v. Include snapshots of simulation output to illustrate the correctness of your models.