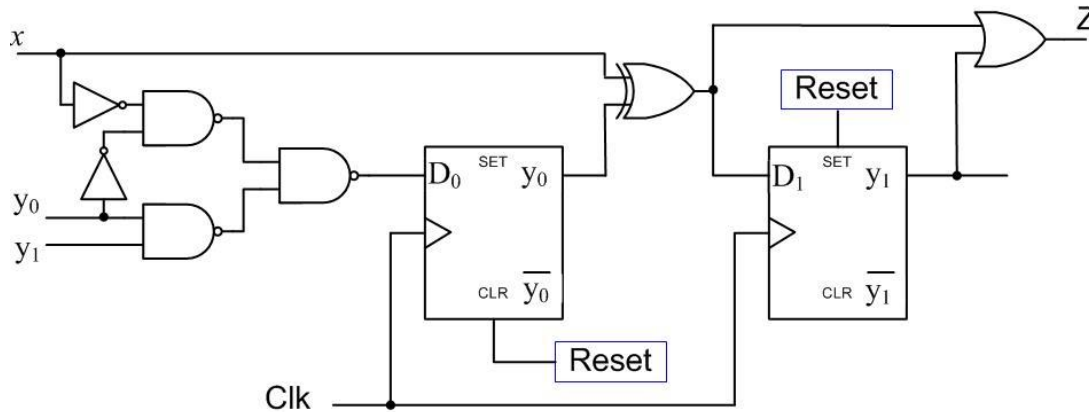


COE 202, Term 151
Digital Logic Design

Quiz# 5

Date: Thursday, Dec. 10

Q1. The sequential circuit shown below has a single output Z, an input x together with a Reset input to initialize the circuit. Note that the used D-FFs have direct/asynchronous Clear and Set inputs (shown in the figure as CLR and SET).



a. Is the circuit type Mealy or Moore? Why?

Mealy since Z depends on the input x.

b. Derive expressions for the D₀ and D₁ flip flop inputs and the external output Z.

$$D_0 = y_1 y_0 + \bar{x} \bar{y}_0$$

$$D_1 = y_0 \oplus x$$

$$Z = y_1 + D_1$$

c. Derive the state transition table of the circuit.

PS (y ₁ y ₀)	NS (y ₁ ⁺ y ₀ ⁺)		Z	
	x=0	x=1	x=0	x=1
0 0	0 1	1 0	0	1
0 1	1 0	0 0	1	0
1 1	1 1	0 1	1	1
1 0	0 1	1 0	1	1

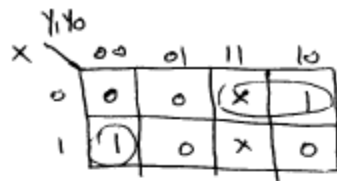
d. What is the circuit initial state?

y₁y₀=10

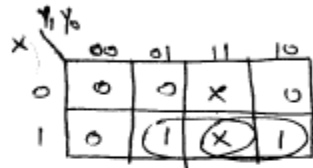
Q2. Consider the following state transition table for a synchronous sequential circuit that multiplies a binary number by 3 i.e. $Z=3*X$. The circuit has a single input X , a single output Z , and two state variables Y_0 , and Y_1 . The states are encoded using binary codes **00**, **01**, **10**.

PS ($Y_1 Y_0$) ^t	NS ($Y_1 Y_0$) ^{t+1}		Z	
	X = 0	X = 1	X = 0	X = 1
0 0	0 0	0 1	0	1
0 1	0 0	1 0	1	0
1 0	0 1	1 0	0	1

Using D-FFs and minimal combinational logic, determine the equations for the D-FF inputs and the output Z for this circuit and draw the resulting circuit. State 00 is the reset state.

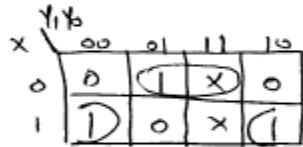


$$D_0 = \bar{x} Y_1 + x \bar{Y}_1 \bar{Y}_0$$



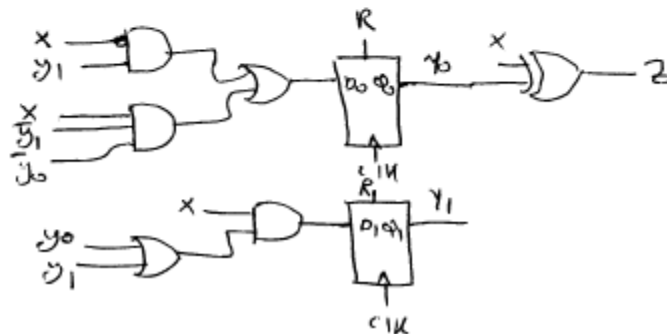
$$D_1 = x Y_1 + x Y_0$$

$$= x (Y_1 + Y_0)$$



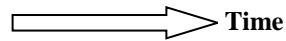
$$Z = \bar{x} Y_0 + x \bar{Y}_0$$

$$= x \oplus Y_0$$



Q3. It is required to design a synchronous sequential circuit that receives a serial sequence of **3-bit codes** through input **X** and produces **1** through output **Y** when the received 3-bit code equals either 010 or 110 (i.e., either 0 followed by 1 followed by 0, or 1 followed by 1 followed by 0). Assume the availability of an asynchronous reset input to reset the machine to a reset state. Draw the state diagram of the circuit assuming a Mealy model with minimum number of states. *You are not required to derive the equations and the circuit.* The following is an example of an input and output sequence:

Example:



Input	X	0 1 0 0 0 1 0 0 1 1 0 1 1 1 0
Output	Y	0 0 1 0 0 0 0 0 0 0 0 0 0 0 1

