

## COE 405, Term 131

## Design &amp; Modeling of Digital Systems

## Quiz# 2

Date: Thursday, October 24, 2013

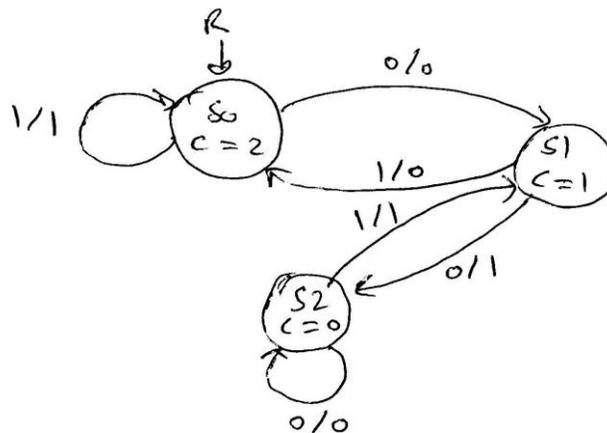
- Q.1.** It is required to design a sequential circuit that has a single input X and a single output Y. The circuit receives an unsigned number serially through the input X from the least significant bit (LSB) to the most significant bit (MSB), and computes the equation  $Y=3*X+2$  and generates the output serially from the least significant bit to the most significant bit. The circuit has an additional reset input R which resets the circuit into an initial state. The following are examples of input and output data:

Examples:

		LSB			MSB		
Input	X	0	1	1	0	0	Input=6 Output=20
Output	Y	0	0	1	0	1	

		LSB			MSB		
Input	X	1	1	0	0	0	Input=3 Output=11
Output	Y	1	1	0	1	0	

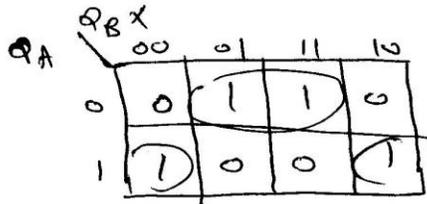
Draw the state diagram of the circuit assuming a **Mealy** model.



**Q.2.** Consider the following state table for an FSM which has a single input X, a single output Z:

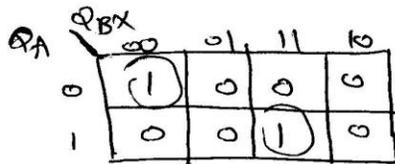
$Q_A$	$Q_B$	X	$Q_A^+$	$Q_B^+$	Z
0	0	0	0	1	1
0	0	1	1	0	0
0	1	0	0	0	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	0	0	1
1	1	0	1	0	0
1	1	1	0	1	0

Implement the circuit for the FSM using D-FFs with minimal area.

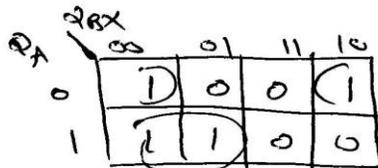


$$D_A = \bar{Q}_A X + Q_A \bar{X}$$

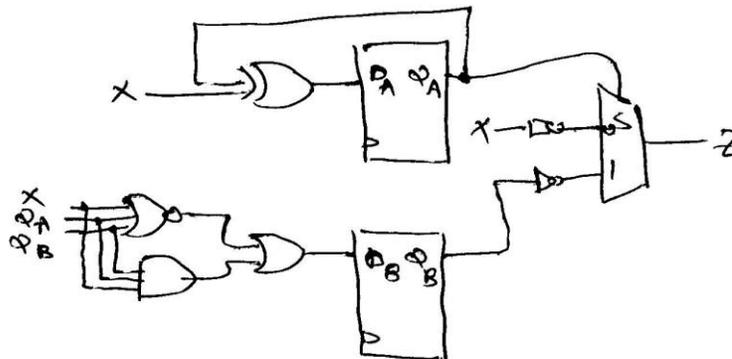
$$= Q_A \oplus X$$



$$D_B = \bar{Q}_A \bar{Q}_B \bar{X} + Q_A Q_B X$$



$$Z = \bar{Q}_A \bar{X} + Q_A \bar{Q}_B$$

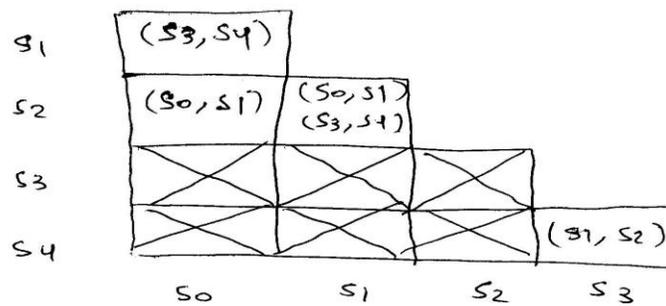


**Q.3.** Consider the given FSM that has 5 states, one input (X) and one output (Z), represented by the following state table:

Present State	Next State, Z	
	X=0	X=1
S0	S3, 0	S0, 0
S1	S4, 0	S0, 0
S2	S3, 0	S1, 0
S3	S2, 1	S2, 0
S4	S2, 1	S1, 0

- (i) Determine the equivalent states.  
(ii) Reduce the state table into the minimum number of states and show the reduced state table.

(i)



Equivalent states are:

$(S_0, S_1), (S_0, S_2), (S_1, S_2), (S_3, S_4)$

$\Rightarrow (S_0, S_1, S_2), (S_3, S_4)$

(ii) Reduced State Table:

P.S.	N.S., Z	
	X=0	X=1
S <sub>012</sub>	S <sub>34</sub> , 0	S <sub>012</sub> , 0
S <sub>34</sub>	S <sub>012</sub> , 1	S <sub>012</sub> , 0