National Chung Cheng University
Department of Electrical Engineering
Logic Design, Fall 2016

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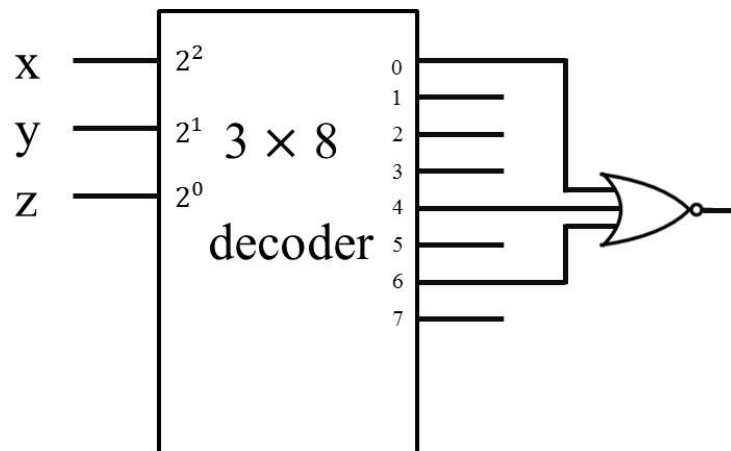TAs: Guan-Hong Liou & Yan-Yu Su & Shuo-Hui Wang

Quiz #4

1. Using **a decoder** and **a NOR gate**, design the combinational circuit defined by the following Boolean function: (20 points)
   $F = (y + z)(x' + z)$
   Solution:

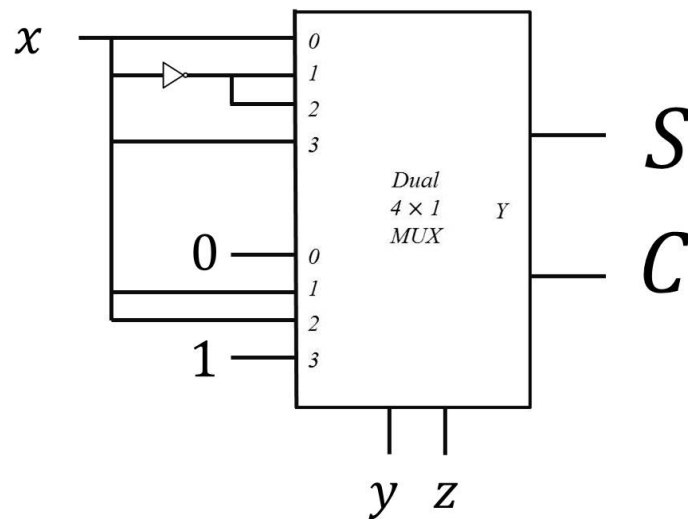| x \ yz	00	01	11	10
0	0			
1	0			0

$F(x, y, z) = \prod(0, 4, 6)$

$\{x'y'z' + xy'z' + xyz'\}' = (x + y + z)(x' + y + z)(x' + y' + z)$

2. Implement a full adder with two 4×1 multiplexers.
   (20 points)
   Solution:

x	y	z	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

S	I_0	I_1	I_2	I_3
x'	0	1	1	0
x	1	0	0	1
	x	x'	x'	x

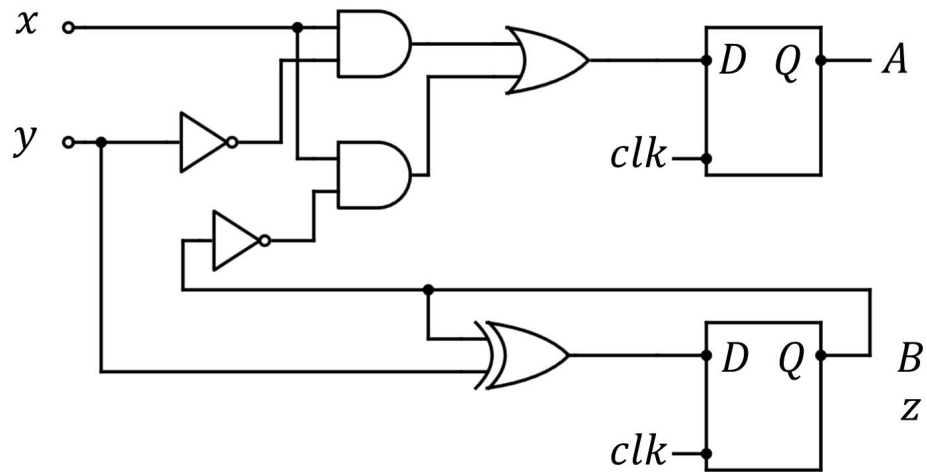| C	I_0	I_1	I_2	I_3
x'	0	0	0	1
x	0	1	1	1
	0	x	x	1

3. A sequential circuit with two D Flip-Flops A and B, two inputs, x and y; and one output z is specified by the following next-state a nd output equations:
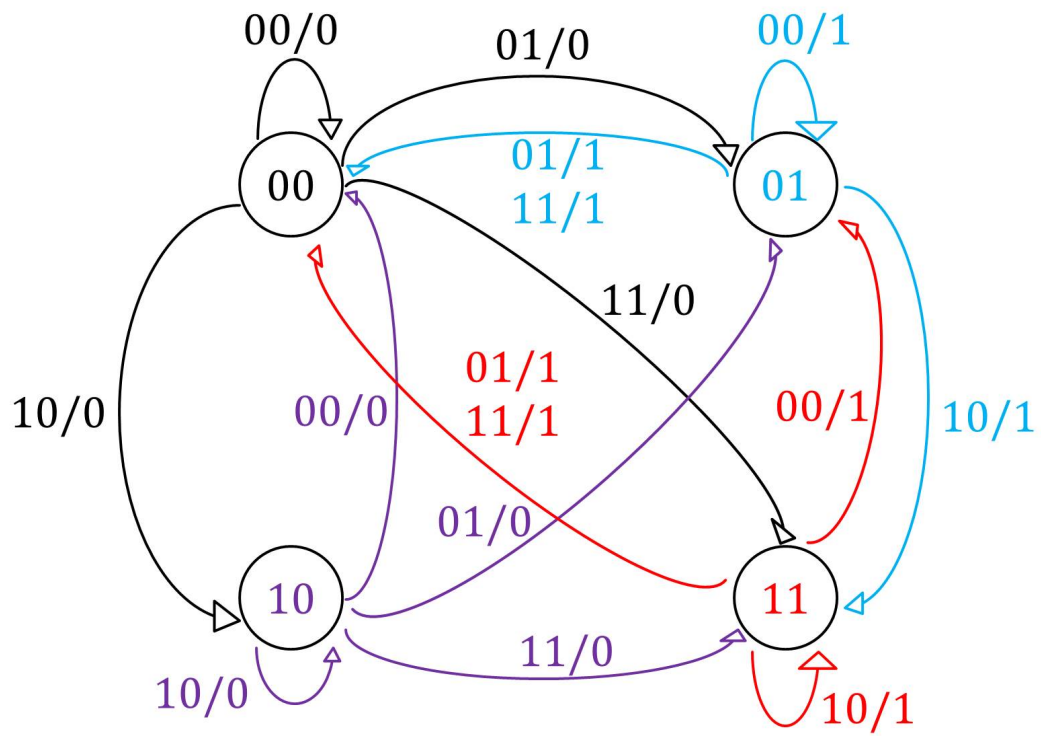
$$A(t+1) = xy'+xB'$$
$$B(t+1) = y \oplus B$$
$$z = B$$

(a) Draw the logic diagram of the circuit. (15 points)

(b) List the state table for the sequential circuit. (15 points)

| A(t)	B(t)	x	y	A(t+1)	B(t+1)	z
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	1	0	0
0	0	1	1	1	1	0
0	1	0	0	0	1	1
0	1	0	1	0	0	1
0	1	1	0	1	1	1
0	1	1	1	0	0	1
1	0	0	0	0	0	0
1	0	0	1	0	1	0
1	0	1	0	1	0	0
1	0	1	1	1	1	0
1	1	0	0	0	1	1
1	1	0	1	0	0	1
1	1	1	0	1	1	1
1	1	1	1	0	0	1

(c) Draw the corresponding state diagram. (15 points)

4. For the following state table:

Present State	Next state		Output	
	x = 0	x = 1	x = 0	x = 1
a	a	b	0	0
b	c	d	0	0
c	a	d	0	0
d	g	a	1	0
e	a	f	0	1
f	g	f	0	1
g	a	f	0	1
h	g	a	1	0

(a) Draw the corresponding state diagram. (5 points)
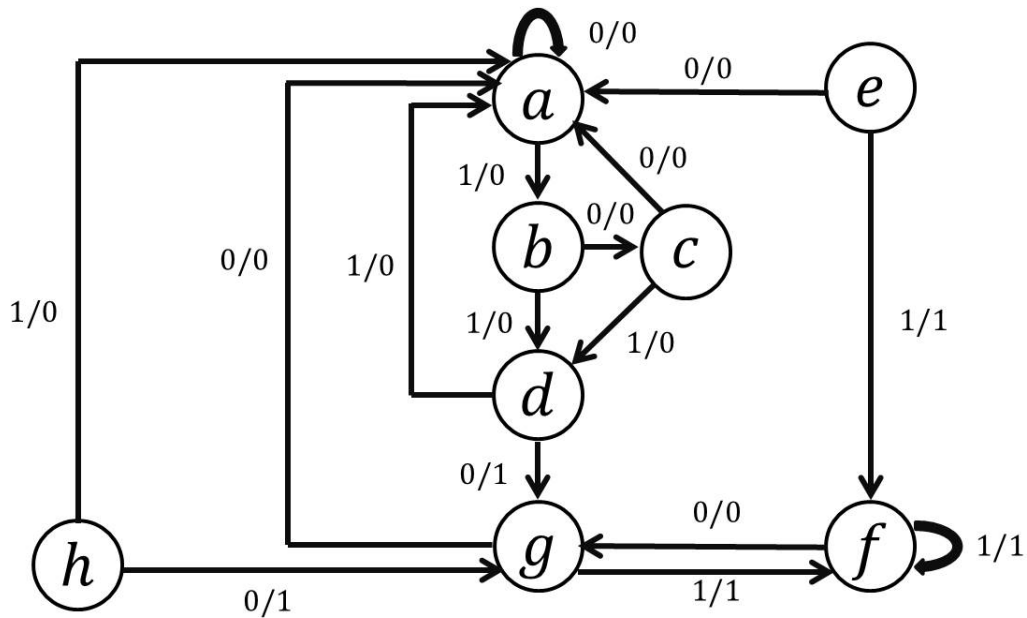
(b) Tabulate the reduced state table. (5 points)

Present State	Next state		Output	
	x = 0	x = 1	x = 0	x = 1
a	a	b	0	0
b	c	d	0	0
c	a	d	0	0
d	g	a	1	0
e	a	f	0	1
f	g	f	0	1
g	a	f	0	1
h	g	a	1	0

Present State	Next state		Output	
	x = 0	x = 1	x = 0	x = 1
a	a	b	0	0
b	c	d	0	0
c	a	d	0	0
d	e	a	1	0
e	a	f	0	1
f	e	f	0	1

(c) Draw the state diagram corresponding to the reduced state table. (5 points)