디지털시스템입문

Solutions to Final Exam

Problem 1 [20 points]

Given $X = (1101010)_2$ and $Y = (0101011)_2$, (a) find $X - Y$, and (b) find $Y - X$ using 1's complements.

1-(a)

$X - Y = 1101010 - 0101011$

```
  1101010   (= X)
+ 1010100   (= 1's complement of Y)
-------------
 1 0111110  (= Sum)

   0111110
+        1  (= End-around carry)
--------------
=  0111111  (= Answer)
```

1-(b)

$Y - X = 0101011 - 1101010$

```
  0101011
+ 0010101   (= 1's complement of X)
--------------
  1000000   (= Sum)
```

There is no end-carry. Therefore, the answer is

$Y - X = -(1\text{'s complement of } 1000000)$

$= \mathbf{-0111111}$

Problem 2 [20 points]

(a) By using K-maps, simplify the Boolean function $F(w, x, y, z) = \Sigma(4, 5, 6, 7, 12)$ with don't-care function $d(w, x, y, z) = \Sigma(0, 8, 13)$, and (b) draw the logic diagram of the simplified Boolean function F.

2-(a)

wxyz	F
0000	X
0001	0
0010	0
0011	0
0100	1
0101	1
0110	1
0111	1
1000	X
1001	0
1010	0
1011	0
1100	1
1101	X
1110	0
1111	0

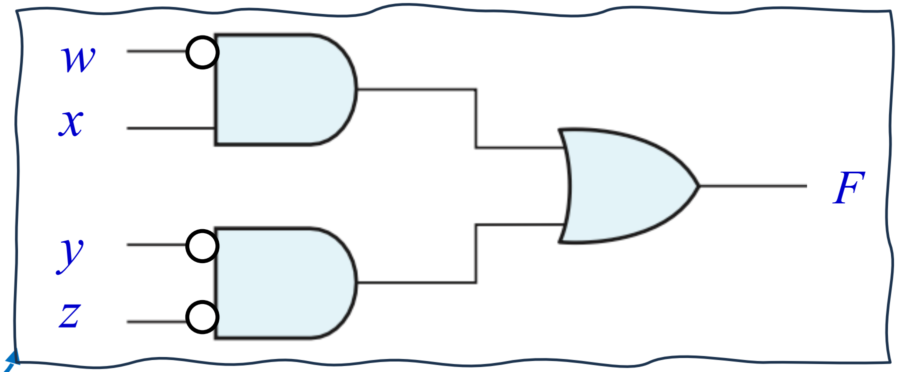
wx \ yz	00	01	11	10
00	m_0 X	m_1	m_3	m_2
01	m_4 1	m_5 1	m_7 1	m_6 1
11	m_{12} 1	m_{13} X	m_{15}	m_{14}
10	m_8 X	m_9	m_{11}	m_{10}

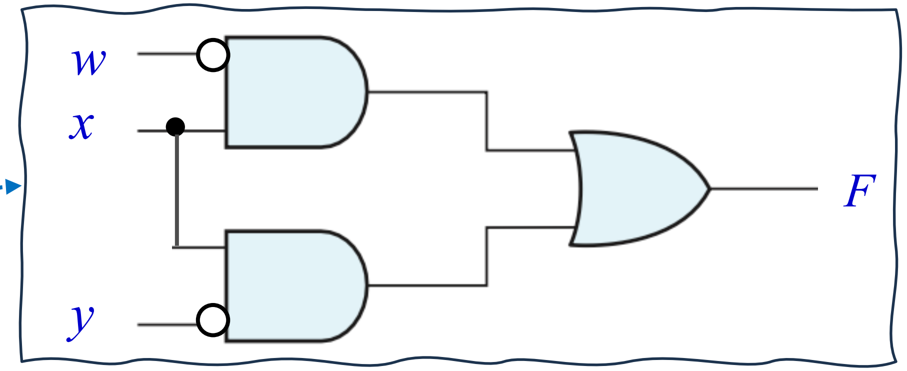
$$F(w, x, y, z) = w'x + y'z'$$

or

$$F(w, x, y, z) = w'x + xy'$$

2-(b)





Problem 3 [30 points] (1/4)

Using *JK* flip-flops,

(a) Design a counter with the following repeated binary sequence: 0, 1, 2, 3, 4, 5, 6.

(b) Draw the state transition diagram of the counter.

(c) Draw the logic diagram of the counter.

3-(a) State table

Present State	Next state	Flip-flop inputs		
ABC	ABC	J_A K_A	J_B K_B	J_C K_C
000	001	0 X	0 X	1 X
001	010	0 X	1 X	X 1
010	011	0 X	X 0	1 X
011	100	1 X	X 1	X 1
100	101	X 0	0 X	1 X
101	110	X 0	1 X	X 1
110	000	X 1	X 1	0 X
111	XXX	X X	X X	X X

Excitation Table

$Q(t)$	$Q(t+1)$	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

(a) *JK* Flip-Flop

Problem 3 (2/4)

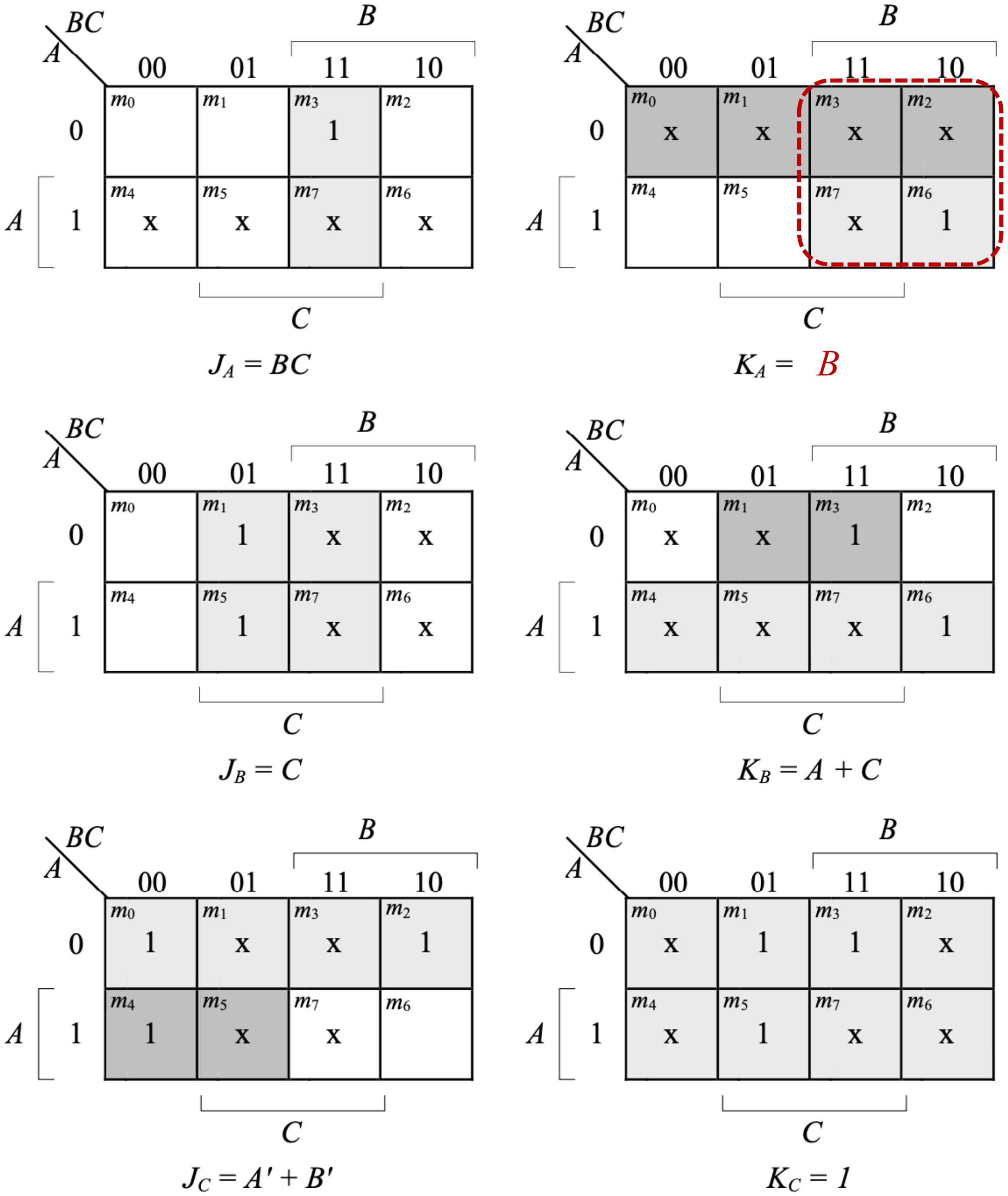
3-(a) K-Maps

The simplified flip-flop input equations drived from K-maps are:

$J_A = BC$
$K_A = B$

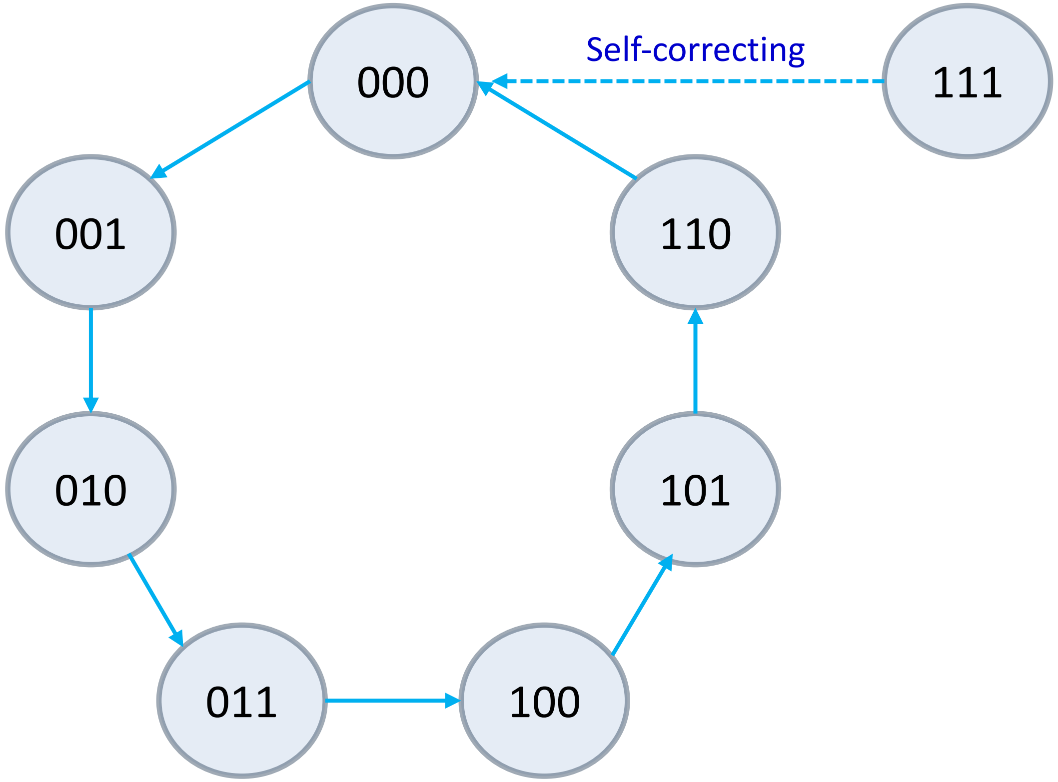
$J_B = C$
$K_B = A+C$

$J_C = A'+B'$
$K_C = 1$



Problem 3 (3/4)

3-(b) State transition diagram



Problem 3 (4/4)

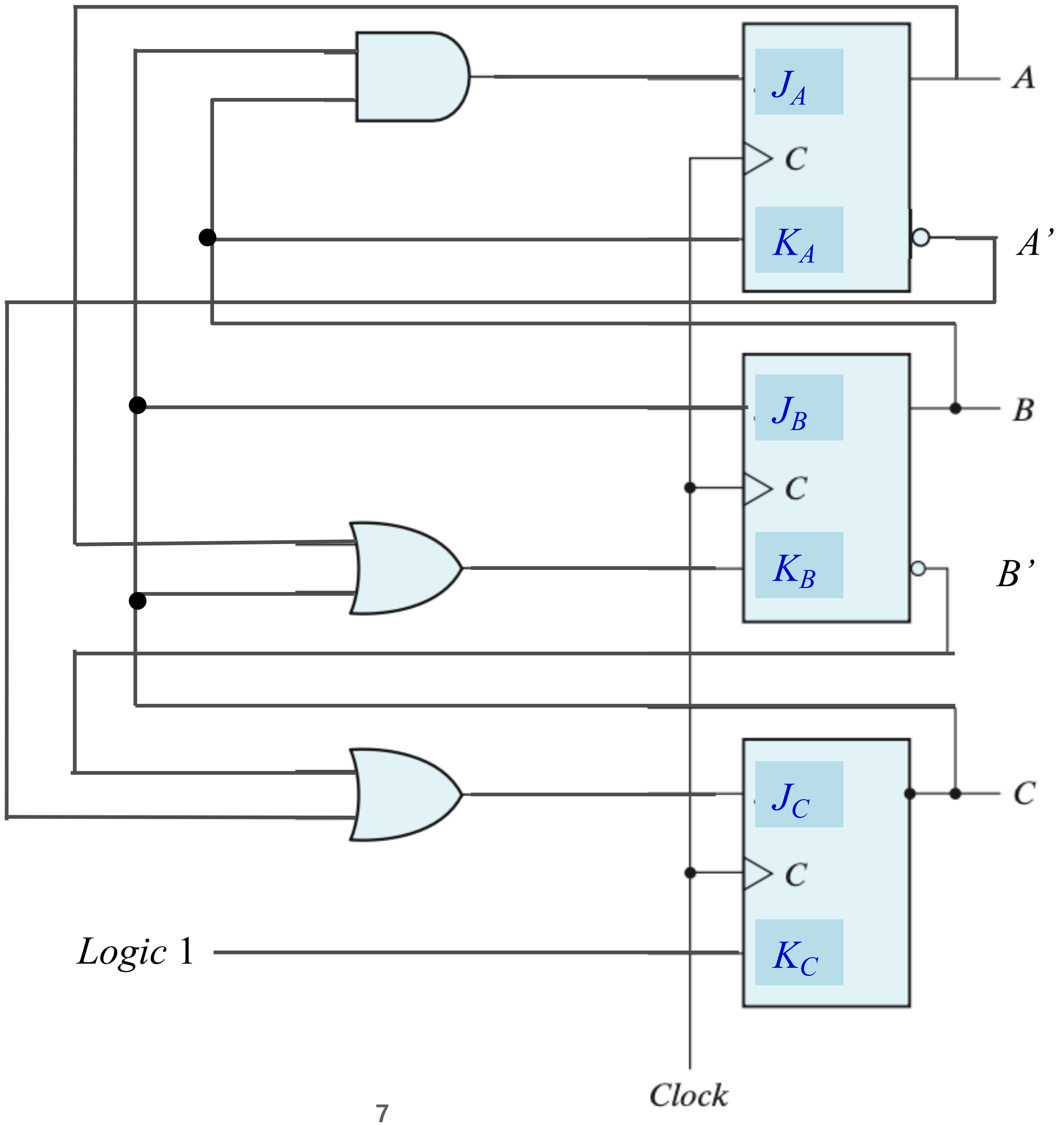
JK Flip-Flop			
J	*K*	$Q(t+1)$	
0	0	$Q(t)$	No change
0	1	0	Reset
1	0	1	Set
1	1	$Q'(t)$	Complement

3-(c) Logic circuit diagram

$J_A = BC$
$K_A = B$

$J_B = C$
$K_B = A+C$

$J_C = A'+B'$
$K_C = 1$



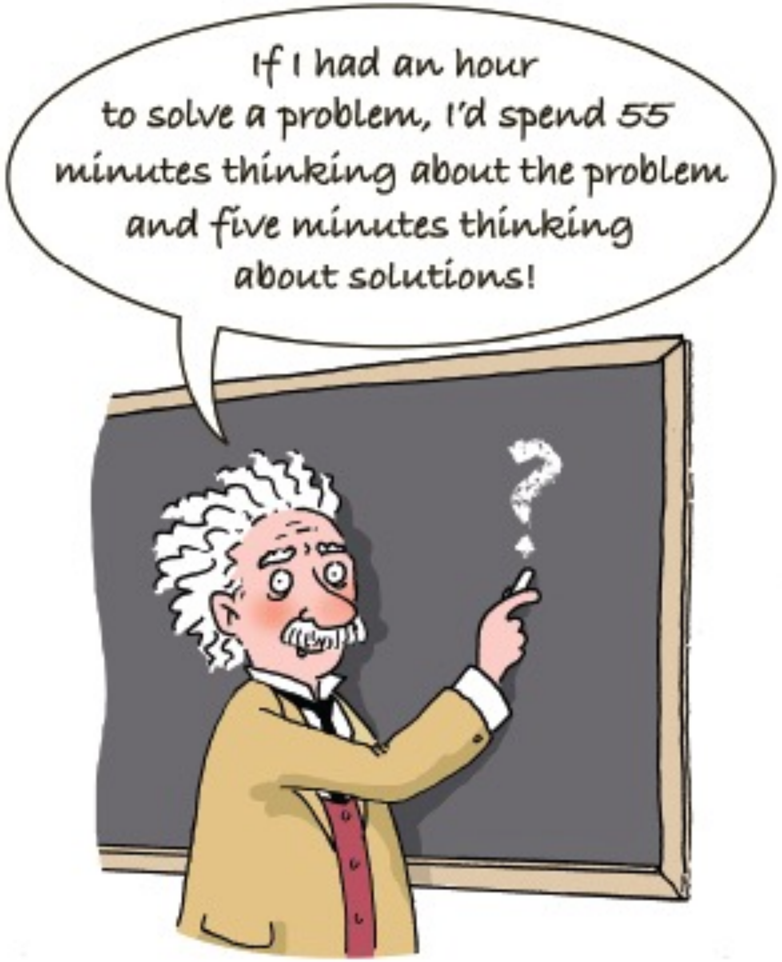
A: 1 → 0

B: 1 → 0

C: 1 → 0

Problem 4 [30 points]

Problem 4 is defined for yourself.



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