

Part 1: 1. a) asynchronous

b) active high

c) reset the state to 0

2.

State table.		Next state		out put
current state		$w=0$	$w=1$	
A		A	B	0
B		A	C	0
C		E	D	0
D		E	F	0
E		A	G	0
F		E	F	1
G		A	C	1

$y_3 y_2 y_1 = 000$	A
001	B
010	C
011	D
100	E
101	F
110	G

current state	next state		Z output
	w=0	w=1	
000	000	001	0
001	000	010	0
010	100	011	0
011	100	101	0
100	000	110	0
101	100	101	1
110	000	010	1

K map, get expression of  $Y_3, Y_2, Y_1, Z$

$Y_1$  K-map

$Y_2 Y_1$ \ $Y_3 W$	00	01	11	10
00	0	1	0	0
01	0	0	1	0
11	0	1	X	X
10	0	1	0	0

$$Y_1 = \overline{Y_3} W \overline{Y_1} + \overline{Y_3} W Y_2 + Y_3 W Y_1$$

$Y_2 - k \text{ map}$

$Y_2 \backslash Y_1$	$Y_3 W$	00	01	11	10
00	0	0	0	0	0
01	0	0	0	0	0
11	0	0	0	X	X
10	0	0	1	1	0

$$Y_2 = Y_3 W \bar{Y}_1 + \bar{Y}_3 W \bar{Y}_2 \bar{Y}_1 + Y_2 \bar{Y}_1 W$$

$Y_3$  - K map

$y_2 y_1 \backslash y_3$	00	01	11	10
00	0	0	1	0
01	0	0	1	1
11	1	1	X	X
10	1	0	0	0

$$Y_3 = y_2 y_1 + y_3 y_1 + y_3 \overline{y_1} y_2 + \overline{y_3} \overline{y_1} y_2$$

$Z:$

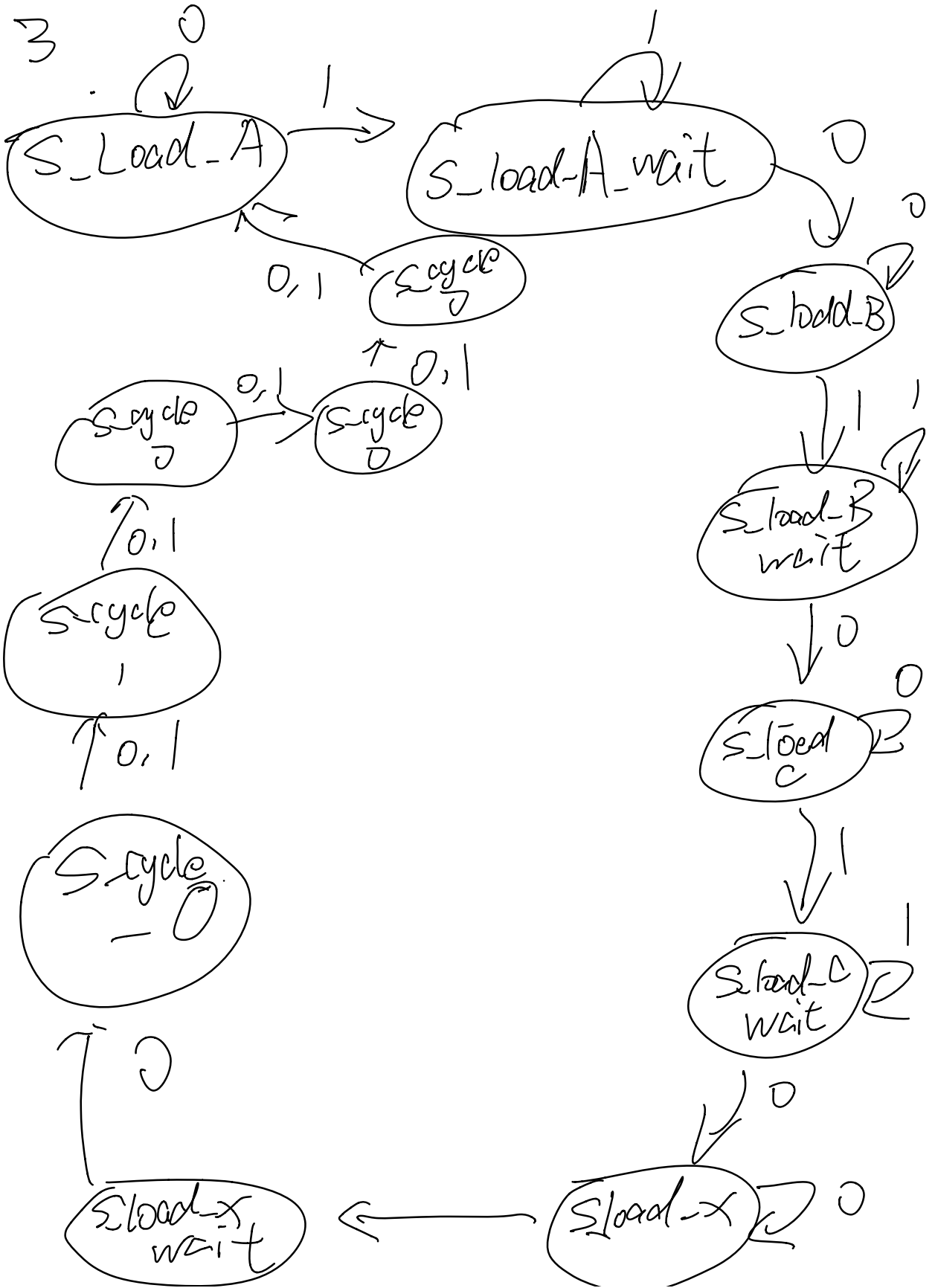
$Y_2 \backslash Y_1$	$00$	$01$	$11$	$10$
$00$	0	0	1	0
$01$	0	0	1	0
$11$	0	1	X	X
$10$	0	0	0	0

Part 2:

2)

state	ld-a	ld-b	ld-c	ld-x	select-a	select-b	alu-op	alu-out	ld-r
0000	1	0	0	0	00	00	0	0	0
0001	0	1	0	0	00	00	0	0	0
0010	0	0	1	0	00	00	0	0	0
0011	0	0	0	1	00	00	0	0	0
0100	0	1	0	0	11	01	1	1	0
0101	1	0	0	0	00	01	0	1	0
0110	0	1	0	0	11	11	1	1	0
0111	0	1	0	0	01	10	1	1	0
1000	0	0	0	0	00	01	0	0	1

step1: load A to  $R_A$   
step2: load B to  $R_B$   
step3: load C to  $R_C$   
step4: load X to  $R_X$   
step5: calculate  $Bx$ , save to  $R_B$   
step6: calculate  $Bx+A$ , save to  $R_A$   
step7: calculate  $x^2$ , save to  $R_B$   
step8: calculate  $Cx^2$ , save to  $R_B$   
step9: calculate  $Cx^2+Bx+A$





① alu op

$y_1 y_0 \backslash y_2 y_1$	00	01	11	10
00	0	1	X	0
01	0	0	X	X
11	0	1	X	X
10	0	1	X	X

alu op:  $y_1 y_2 + y_2 y_0$

② 1d- a

$y_3 \backslash y_2$ $y_1 y_0$	00	01	11	10
00	1	0	X	0
01	0	1	X	X
11	0	0	X	X
10	0	0	X	X

$\overline{y_3} \overline{y_2} \overline{y_1} \overline{y_0} + \overline{y_3} y_2 \overline{y_1} y_0$

② 1d - b

cg/c

0 (0000)

1 (0001)

2 (0010)

3 (0011)

4 (0100)

5 (0101)

6 (0110)

7 (0111)

8 (1000)

1d - b

0

1

0

0

1

0

1

1

0

$y_2 y_1 y_0$	00	01	11	10
00	0	1	x	0
01	1	0	x	x
11	0	1	x	x
10 <td>0</td> <td>1</td> <td>x</td> <td>x</td>	0	1	x	x

$$y_2 \bar{y}_1 y_0 + y_2 y_1 + y_2 \bar{y}_0$$

④ 1d-C

cgCk

0 (0000)

1 (0001)

2 (0010)

3 (0011)

4 (0100)

5 (0101)

6 (0110)

7 (0111)

8 (1000)

1d-C

0

0

1

0

0

0

0

0

0

$y_3 y_2$					
$y_1 y_0$		$y_3 y_2$		$y_1 y_0$	
		00	01	11	10
00	0	0	0	X	0
01	0	0	0	X	X
11	0	0	0	X	X
10	1	0	0	X	X

$\overline{y_3} \overline{y_2} y_1 y_0$

④  $ld-x$

$cgck$

$ld-x$

0 (0000)

0

1 (0001)

0

2 (0010)

0

3 (0011)

1

4 (0100)

0

5 (0101)

0

6 (0110)

0

7 (0111)

0

8 (1000)

0

$\overline{y_3} \overline{y_2} y_1 y_0$

⑤ alu-select-a

cycle

0 (0000)  
1 (0001)  
2 (0010)  
3 (0011)  
4 (0100)  
5 (0101)  
6 (0110)  
7 (0111)  
8 (1000)

alu-select-a

00  
00  
00  
00  
11  
00  
11  
01  
00

X<sub>1</sub>:

$y_3 y_2$		$y_1 y_0$			
$y_3$	$y_2$	00	01	11	10
		00	01	11	10
0	0	0	1	1	0
0	1	0	0	x	x
1	1	0	0	x	x
1	0	0	1	x	x

$y_2 \overline{y_0}$

$y_3 y_2$   
 $y_1 y_0$

	00	01	11	10
00	0	0	X	0
01	0	0	X	X
11	0	1	X	X
10	0	1	X	X

$$y_2 y_1 + y_2 \bar{y}_0$$

⑥  $alu\_select\_b$

clock

0 (0000)

1 (0001)

2 (0010)

3 (0011)

4 (0100)

5 (0101)

6 (0110)

7 (0111)

8 (1000)

$alu\_select\_b$

00

00

00

00

01

01

11

10

01

$x_1$ :

~~$y_2 y_2$~~

~~$y_1 y_1$~~

00

01

11

10

00

01

11

10

0

0

x

0

x

x

x

x

x

x

$y_2 y_1$



v

$x_0$	$y_3 y_2$		00	01	11	10
$y_1 y_0$						
00		0	1	X	1	
01		0	1	X	X	
11		0	0	X	X	
10		0	1	X	X	

$$y_2 \bar{y}_1 + y_3 \bar{y}_1 + y_2 \bar{y}_0$$

⑦ ld-alu\_out

cycle	ld-alu_out
0 (0000)	0
1 (0001)	0
2 (0010)	0
3 (0011)	0
4 (0100)	1
5 (0101)	1
6 (0110)	1
7 (0111)	1
8 (1000)	0

$y_3 y_2$	00	01	11	10
$y_1 y_0$				
00	0	1	X	0
01	0	1	X	X
10	0	1	X	X
11	0	1	X	X

$y_3$

⑧  $ld_r$

$cg_k$

0 (0000)

1 (0001)

2 (0010)

3 (0011)

4 (0100)

5 (0101)

6 (0110)

7 (0111)

8 (1000)

$ld_r$

0

0

0

0

0

0

0

0

1

⑨

0000  $\rightarrow$  0001  $\rightarrow$  0010  $\rightarrow$  0011

$\rightarrow$  0100  $\rightarrow$  0101  $\rightarrow$  0110  $\rightarrow$  0111

$y_0$ :

$y_3 y_2$	00	01	11	10
$y_1 y_0$				
00	1	1	X	X
01	0	0	X	X
11	0	0	X	X
10	1	1	X	X

$y_3 \overline{y_0}$

$y_3 y_2$	00	01	11	10
$y_1 y_0$				
00	0	0	X	X
01	1	1	X	X
11	0	0	X	X
10	1	1	X	X

$\overline{y_1 y_2}^+$

$y_1 y_0$

$y_2:$

$y_3 y_2$	00	01	11	10
$y_1 y_0$				
00	0	1	X	X
01	0	1	X	X
11	1	0	X	X
10	0	1	X	X

$$\overline{y_3} \overline{y_2} y_1 y_0 + \overline{y_3} y_2 y_1 y_0 + y_2 y_1$$

$y_3$

$y_3 y_2$	00	01	11	10
$y_1 y_0$				
00	0	0	X	X
01	0	0	X	X
11	0	1	X	X
10	0	0	X	X

$$\overline{y_3} y_2 y_1 y_0$$