

LAB REPORT-10

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Submitted by → Sec B

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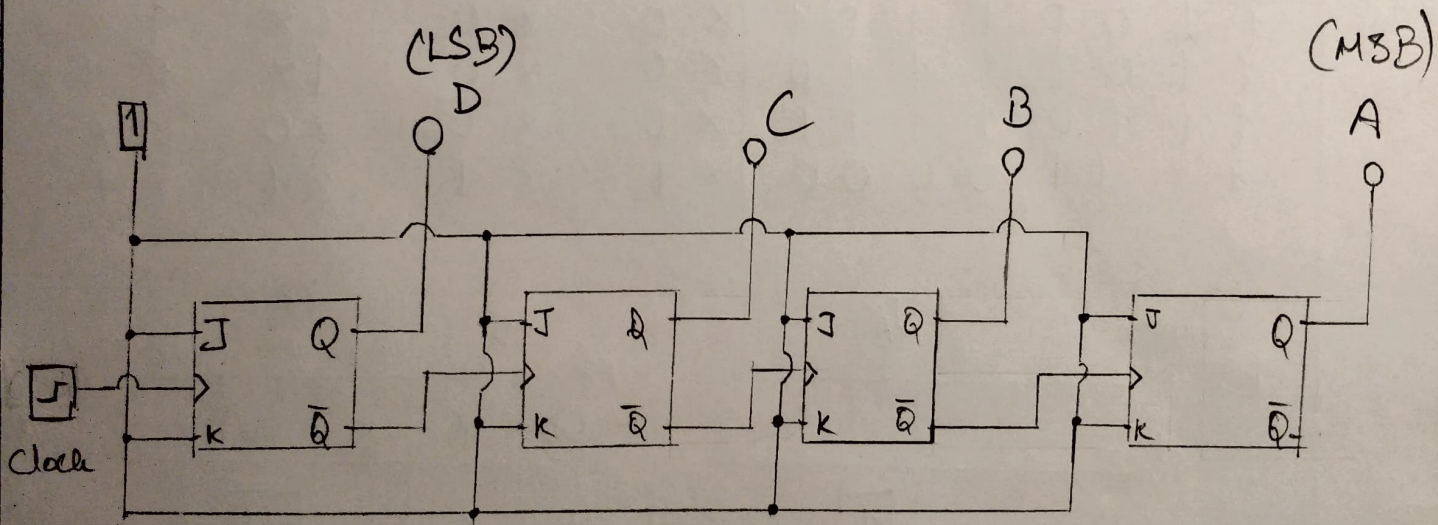
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Counters using JK flip flops.

AIM → To implement 4-bit up and down counters using J-K flip flops.

SOFTWARE USED → Logisim

(I) Asynchronous 4-bit up counter →



(II) Synchronous 4-bit up Counter \rightarrow Present state \rightarrow Next state

A	B	C	D			J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D
0	0	0	0	0	0	0	x	0	x	0	x	1	x
0	0	0	1	0	0	0	x	0	x	1	x	x	1
0	0	1	0	0	0	0	x	0	x	1	x	1	x
0	0	1	1	0	1	0	x	1	x	x	1	x	1
0	1	0	0	0	1	0	x	x	0	0	x	1	x
0	1	0	1	0	1	0	x	x	0	1	x	x	1
0	1	1	0	0	1	0	x	x	0	x	0	1	x
0	1	1	1	1	0	1	x	x	1	x	1	x	1
1	0	0	0	1	1	x	0	0	x	0	x	1	x
1	0	0	1	1	1	x	0	0	x	1	x	x	1
1	0	1	0	1	1	x	0	0	x	x	0	1	x
1	0	1	1	1	1	x	0	1	x	x	1	x	1
1	1	0	0	1	1	x	0	x	0	0	x	1	x
1	1	0	1	1	1	x	0	x	0	1	x	x	1
1	1	1	0	1	1	x	0	x	0	x	0	1	x
1	1	1	1	0	0	x	1	x	1	x	1	x	1

AB	J_A			
	00	01	11	10
00				
01			1	
11	x	x	x	x
10	x	x	x	x

$$J_A = BCD$$

AB	K_A			
	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11			1	
10				

$$K_A = BCD$$

① J_B

AB \	00	01	11	10
00			1	
01	x	x	x	x
11	x	x	x	x
10			1	

$$J_B = CD$$

① K_B

AB \	00	01	11	10
00	x	x	x	x
01			1	
11			1	
10	x	x	x	x

$$K_B = CD$$

① J_C

AB \	00	01	11	10
00		1	x	x
01		1	x	x
11		1	x	x
10		1	x	x

$$J_C = D$$

① K_C

AB \	00	01	11	10
00	x	x	1	
01	x	x	1	
11	x	x	1	
10	x	x	1	

$$K_C = D$$

① J_D

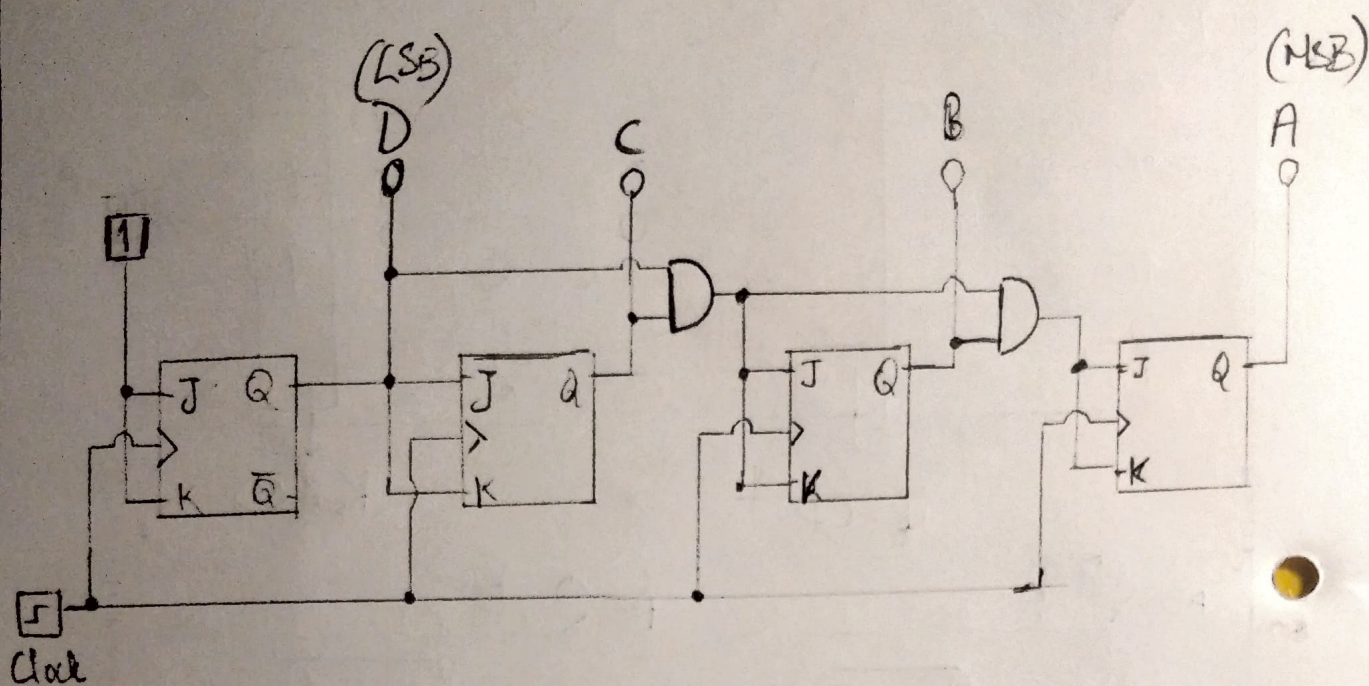
AB \	00	01	11	10
00	1	x	x	1
01	1	x	x	1
11	1	x	x	1
10	1	x	x	1

$$J_D = 1$$

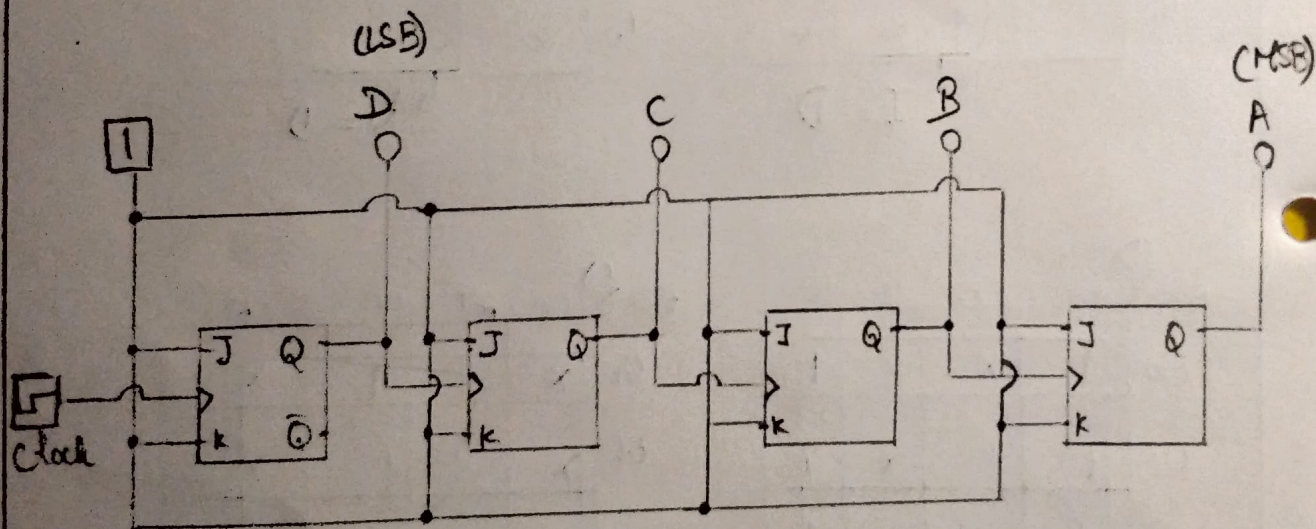
① K_D

AB \	00	01	11	10
00	x	1	1	x
01	x	1	1	x
11	x	1	1	x
10	x	1	1	x

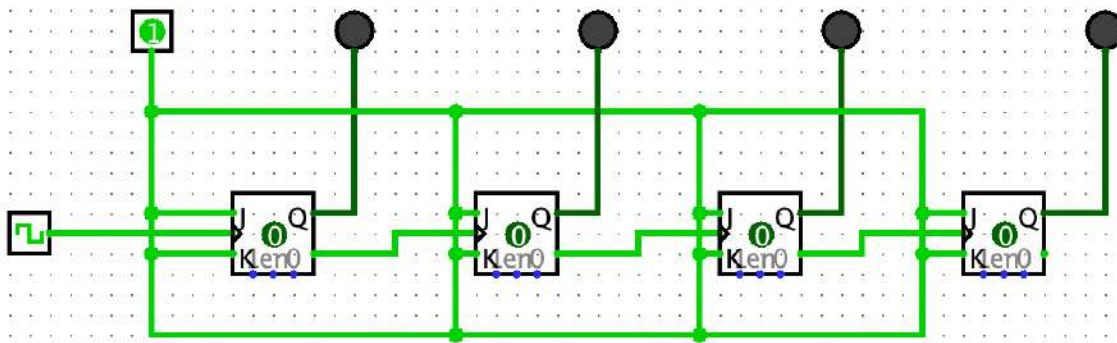
$$K_D = 1$$



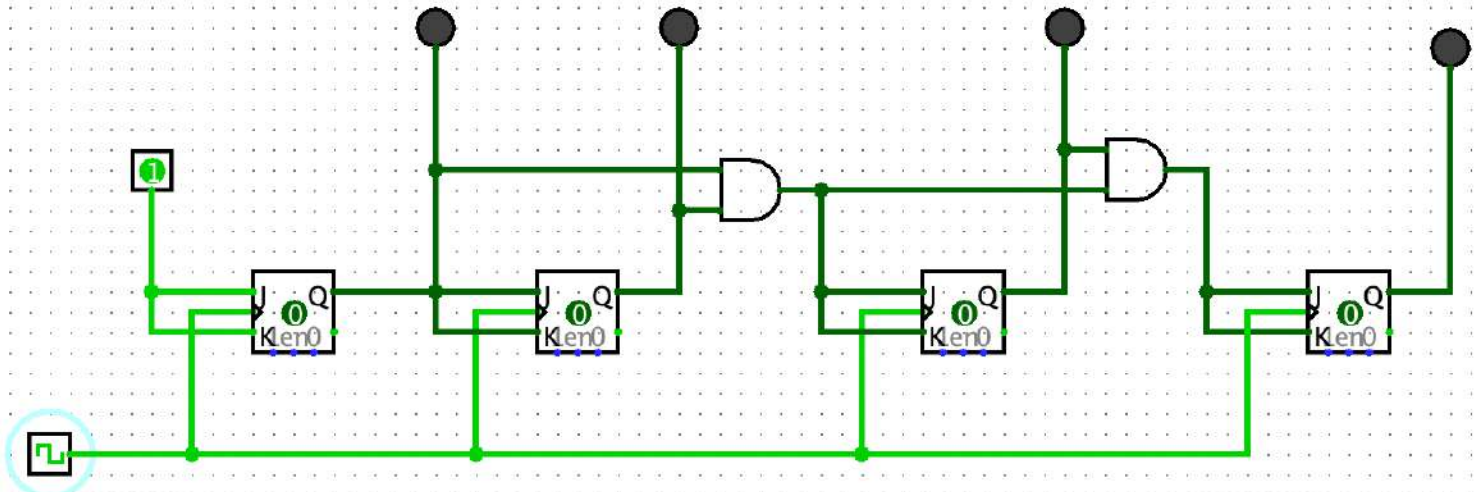
(III) Asynchronous 4-bit down counter →



Asynchronous up counter



Synchronous up counter



(IV) Synchronous 4-bit down counter ->

Present state ->

A B C D	Next state	$J_A K_A$	$J_B K_B$	$J_C K_C$	$J_D K_D$
1 1 1 1	1 1 1 0	X 0	X 0	X 0	X 1
1 1 1 0	1 1 0 1	X 0	X 0	X 1	1 X
1 1 0 1	1 1 0 0	X 0	X 0	0 X	X 1
1 1 0 0	1 0 1 1	X 0	X 1	1 X	1 X
1 0 1 1	1 0 1 0	X 0	0 X	X 0	X 1
1 0 1 0	1 0 0 1	X 0	0 X	X 1	1 X
1 0 0 1	1 0 0 0	X 0	0 X	0 X	X 1
1 0 0 0	0 1 1 1	X 1	1 X	1 X	1 X
0 1 1 1	0 1 1 0	0 X	X 0	X 0	X 1
0 1 1 0	0 1 0 1	0 X	X 0	X 1	1 X
0 1 0 1	0 1 0 0	0 X	X 0	0 X	X 1
0 1 0 0	0 0 1 1	0 X	X 1	1 X	1 X
0 0 1 1	0 0 1 0	0 X	0 X	X 0	X 1
0 0 1 0	0 0 0 1	0 X	0 X	X 1	1 X
0 0 0 1	0 0 0 0	0 X	0 X	0 X	X 1
0 0 0 0	1 1 1 1	1 X	1 X	1 X	1 X

AB \ CD	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11				
10	1			

$$K_A = \overline{B} \overline{C} \overline{D}$$

AB \ CD	00	01	11	10
00	1			
01				
11	X	X	X	X
10	X	X	X	X

$$J_A = \overline{B} \overline{C} \overline{D}$$

J_B

$AB \backslash CD$	00	01	11	10
00	1			
01	x	x	x	x
11	x	x	x	x
10	1			

$$J_B = \bar{C}\bar{D}$$

K_B

$AB \backslash CD$	00	01	11	10
00	x	x	x	x
01	1			
11	1			
10	x	x	x	x

$$K_B = \bar{C}\bar{D}$$

J_C

$AB \backslash CD$	00	01	11	10
00	x 1	x 0	x	x
01	x 1	x 0	x	x
11	x 1	x 0	x	x
10	x 1	x 0	x	x

$$J_C = \bar{D}$$

K_C

$AB \backslash CD$	00	01	11	10
00	x	x	0 1	1
01	x	x	0 1	1
11	x	x	0 1	1
10	x	x	0 1	1

$$K_C = \bar{D}$$

K_D

$AB \backslash CD$	00	01	11	10
00	x	1	1	x
01	x	1	1	x
11	x	1	1	x
10	x	1	1	x

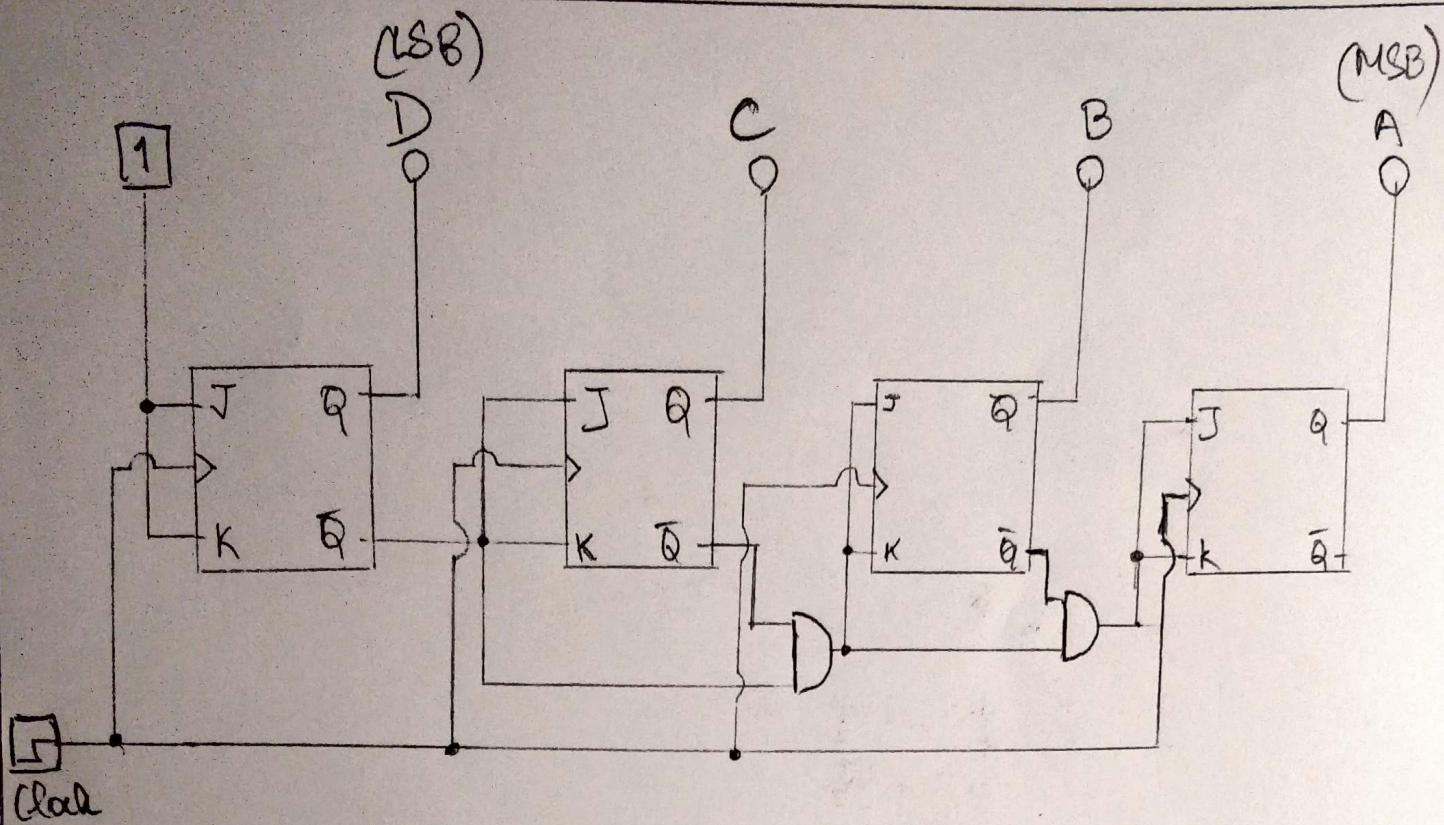
$$K_D = 1$$

J_D

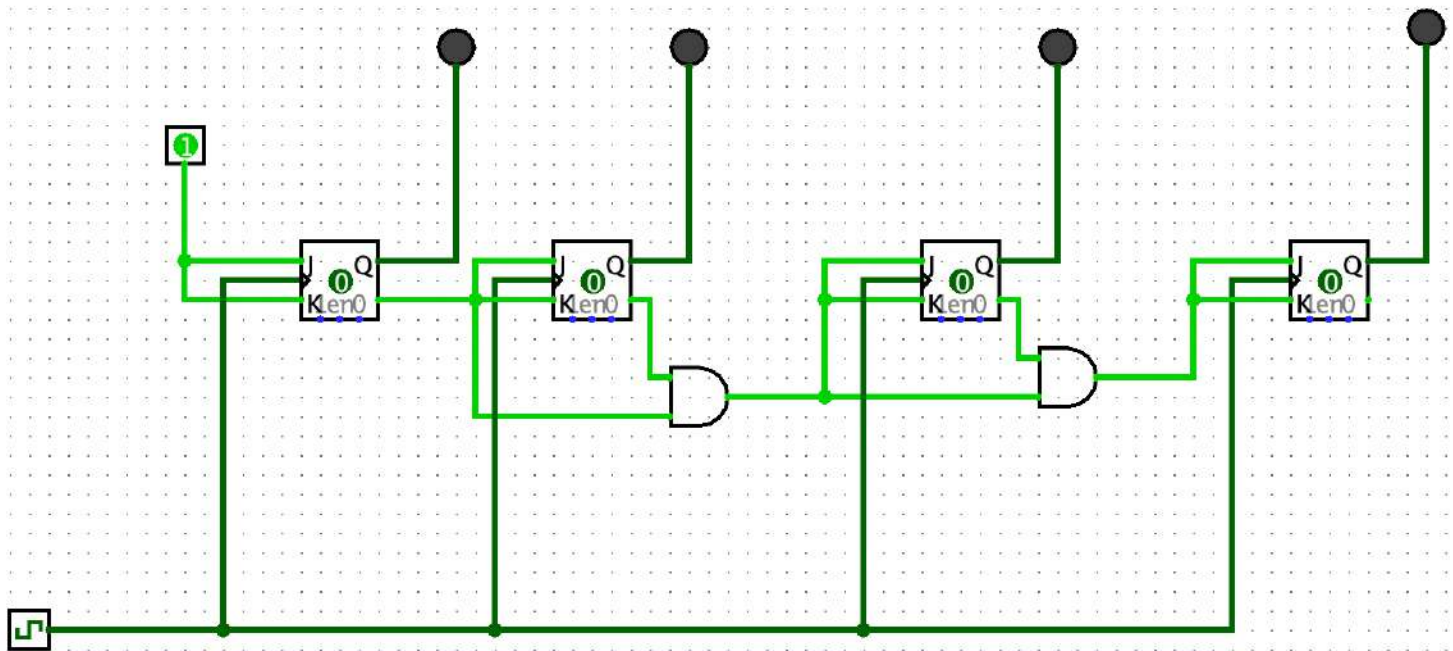
$AB \backslash CD$	00	01	11	10
00	1	x	x	1
01	1	x	x	1
11	1	x	x	1
10	1	x	x	1

$$J_D = 1$$

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Synchronous down counter



Asynchronous down counter

