

Q B1

AIM: To implement a synchronous counter using JK flip flops for the given sequence:

6, 3, 1, 0, 10, 15, 11

DETAILS:

2) JK flip-flop ~~table~~ excitation table:

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

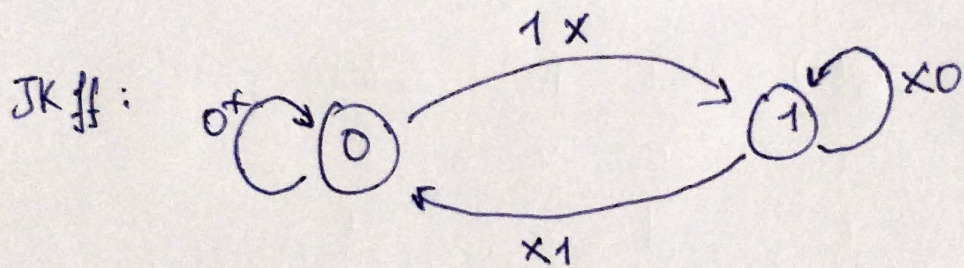
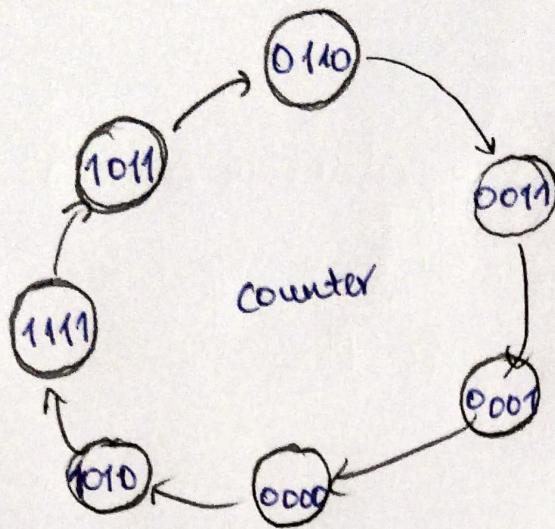
1) JK flip flop truth table:

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

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3) State diagram for:



4) Circuit excitation table:

Present state				Next state				Input to ff			
A	B	C	D	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	0	0	0	0	0
0	0	0	1	0	0	0	1	0	0	0	0
0	0	1	0	0	0	1	1	0	0	0	0
0	0	1	1	0	0	0	1	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	1	0	1	0	1	0	1	0
1	0	1	0	1	1	1	1	x	0	x	1
1	1	1	1	1	0	1	1	x	0	x	0
1	0	1	1	0	1	1	0	x	1	1	x

5) KMaps:

J_A

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

$$J_A = \bar{A}\bar{B}\bar{C}\bar{D}$$

K_A

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

$$K_A = \bar{B}CD$$

J_B

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

$$J_B = A\bar{B}C$$

K_B

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

$$K_B = ACD + \bar{A}BC\bar{D}$$

J_C

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

$$J_C = \bar{A}\bar{B}C\bar{D}$$

K_C

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

$$K_C = \bar{A}\bar{B}D$$

J_D

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

$$J_D = \bar{A}BC\bar{D} + A\bar{B}C$$

K_D

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

$$K_D = A\bar{B}C + \bar{A}\bar{B}\bar{C}$$

6) Boolean expressions: obtained from K maps

$$J_A = A \bar{B} \bar{C} \bar{D} \quad , \quad K_A = \bar{B} C D$$

J_B

$$J_B = A \bar{B} C \quad , \quad K_B = A C D + \bar{A} B C \bar{D}$$

$$J_C = \bar{A} \bar{B} \bar{C} \bar{D} \quad , \quad K_C = \bar{A} \bar{B} D$$

$$J_D = \bar{A} B C \bar{D} + A \bar{B} C \quad , \quad K_D = A \bar{B} C + \bar{A} \bar{B} \bar{C}$$

7) Diagram:

