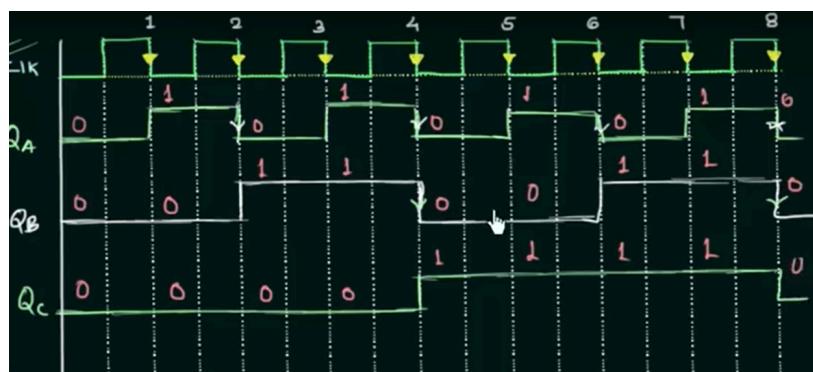
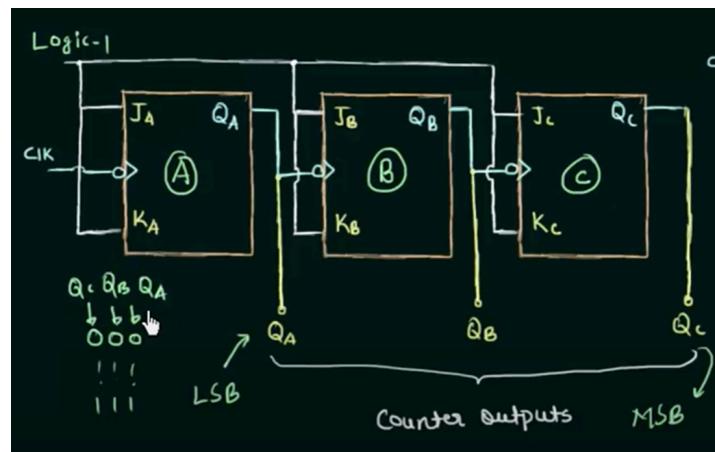


## Classification

Asynchronous/Ripple Counter	Synchronous Counter
<ol style="list-style-type: none"> <li>1. Flip flops are connected in such a way that the o/p of first flip flop drives the clock of next flip flop.</li> <li>2. Flip flops are not clocked simultaneously.</li> <li>3. Circuit is simple for more number of states.</li> <li>4. Speed is slow as clock is propagated through number of stages</li> </ol>	<ol style="list-style-type: none"> <li>1. There is no connection between o/p of first flip flop and clock of next flip flop.</li> <li>2. Flip flops are clocked simultaneously.</li> <li>3. Circuit becomes complicated as number of states increases.</li> <li>4. Speed is high as clock is given at a same time.</li> </ol>

## 3 bit Asynchronous UP Counter



B States

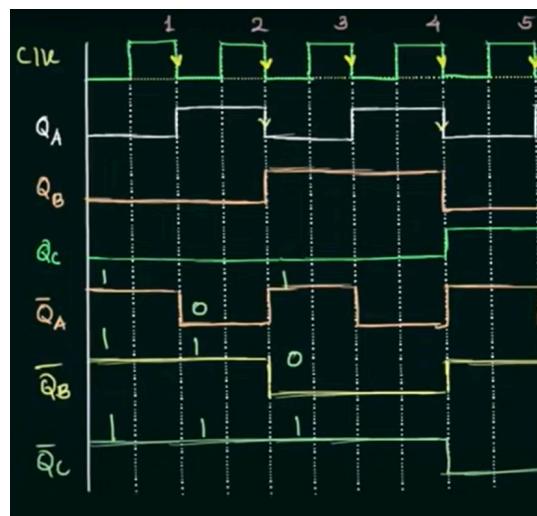
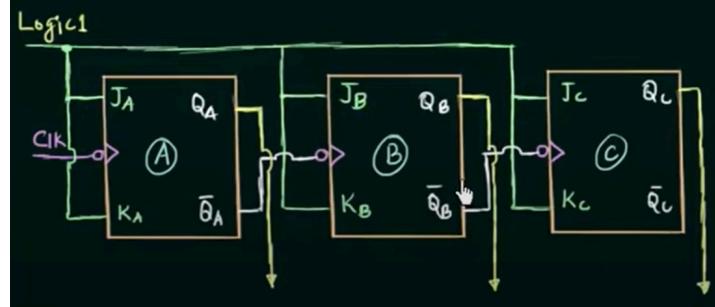
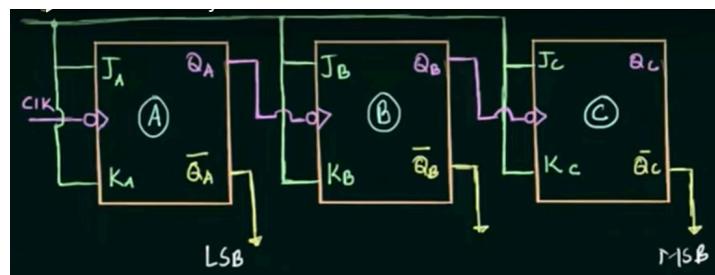
$$2^3 = 2^{\text{3}} = 8$$

Maximum count:-

$$\sqrt{2^3 - 1} = 8 - 1 = 7$$

No. of steps up to 7

### 3 Bit Asynchronous Down Counter



### 3 Bit Asynchronous Up/Down Counter

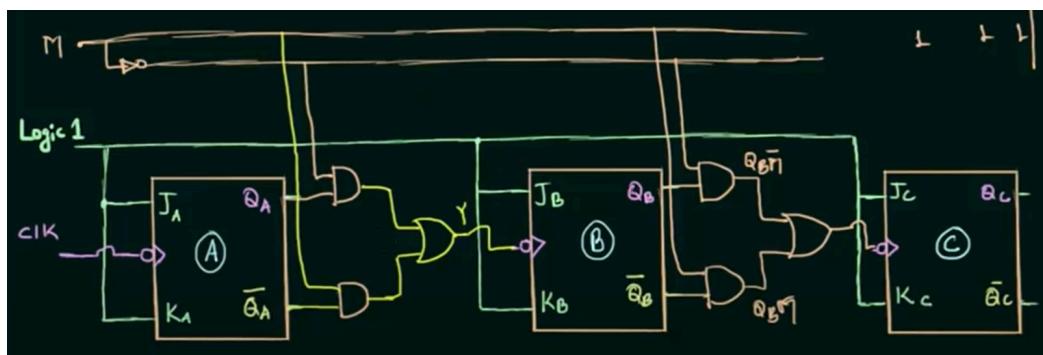
M	Q	$\bar{Q}$	Y
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

$Q$  connected to  $Clk$   
 $Y = \begin{cases} M=0 & \dots \text{Up counting} \\ M=1 & \dots \text{down counting} \end{cases}$   
 $\bar{Q}$  is connected to  $Clk$

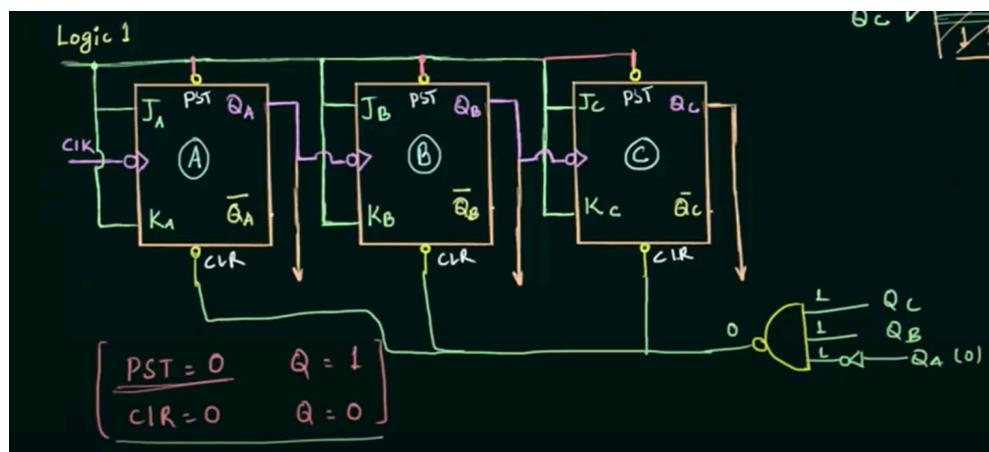
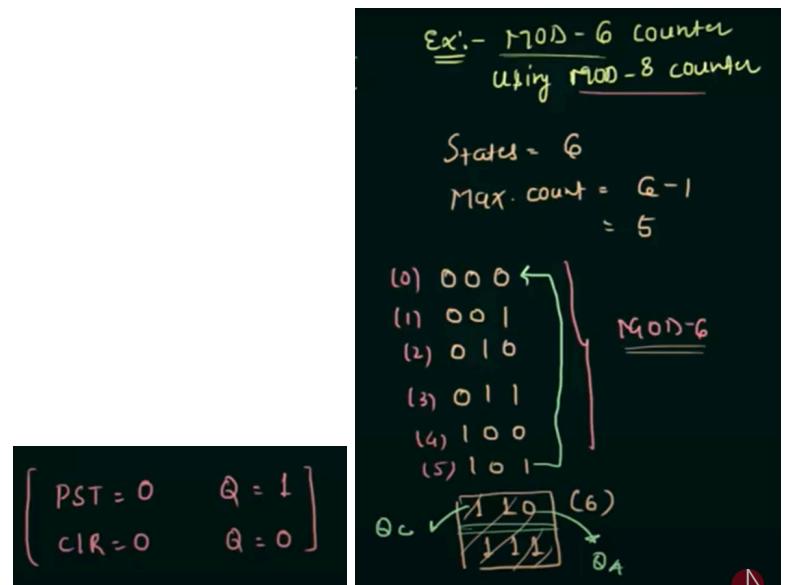
M	Q	$\bar{Q}$	I	II
0	00	01	11	10
0	01	10	01	11
1	10	01	11	00
1	11	00	00	10

$$Y = I + II$$

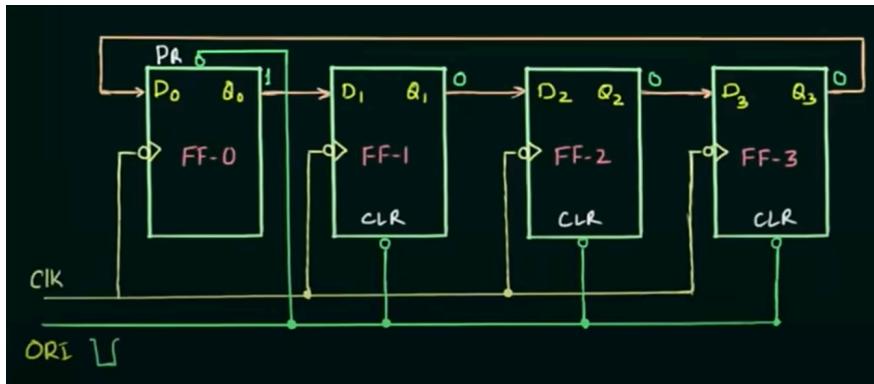
$$Y = \bar{M}Q + M\bar{Q}$$



## Mod-6 Counter



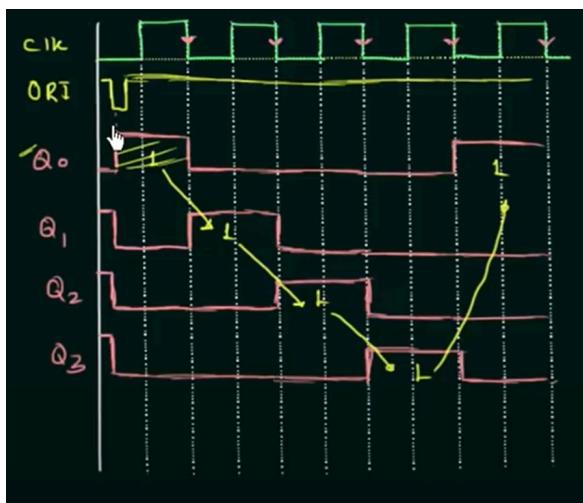
## Ring Counter



*Preseted ↑*

ORI	CLK	$Q_0$	$Q_1$	$Q_2$	$Q_3$
U	X	1	0	0	0
1	↓	0	1	0	0
1	↓	0	0	1	0
1	↓	0	0	0	1
1	↓	1	0	0	0

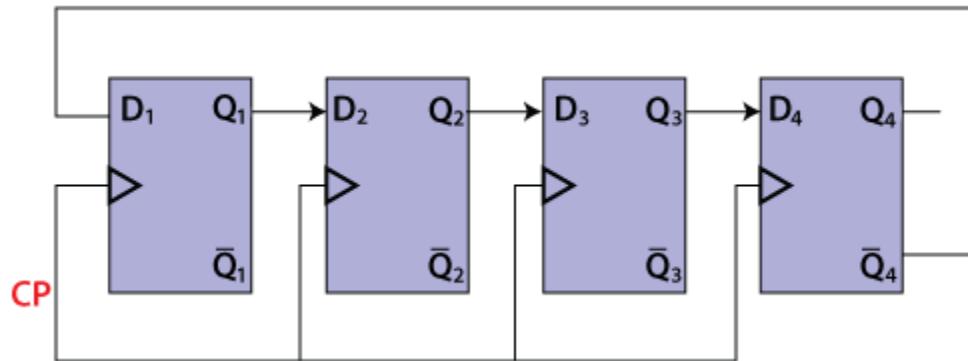
$$\begin{cases} PR = 0 & Q = 1 \\ CLR = 0 & Q = 0 \end{cases}$$



## Johnson Counter

1. No. of states in Johnson counter = No. of flip-flop used
2. Number of used states =  $2^n$

### 3. Number of unused states=2<sup>n</sup> - 2\*n



Truth Table

CP	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
6	0	0	1	1
7	0	1	1	1