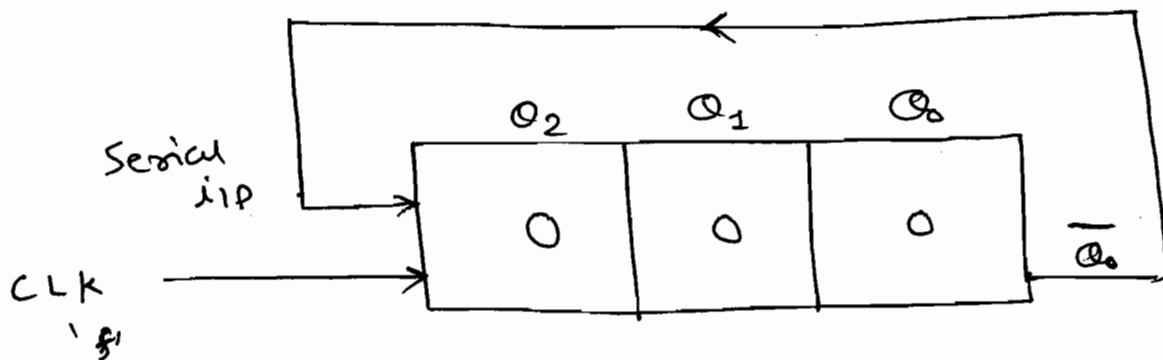


★ 3-Bit Johnson Counter:

(Twisted Counter (or) Switch-tail counter).

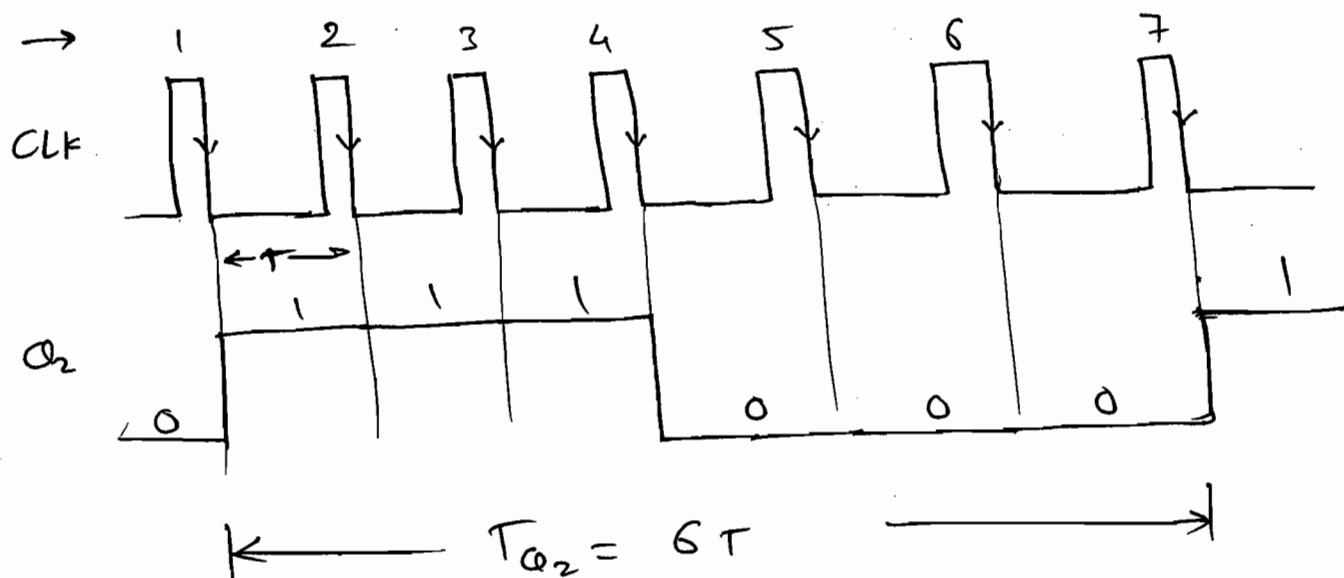
→ Shift Register can be converted into Johnson Counter by making one change.
i.e. $\bar{Q}_0$ is connected to the serial i/p.



6:1 Counter.

CLK	serial i/p $\bar{Q}_0$	Q_2 Q_1 Q_0	Decimal value
0	—	0 0 0	0
1	1 →	1 0 0	4
2	1 →	1 1 0	6
3	1 →	1 1 1	7
4	0 →	0 1 1	3
5	0 →	0 0 1	1
6	0 →	0 0 0	0

⇒ Freq. division:



∴ $T_{Q_2} = 6T$

∴ $f_{Q_2} = f/6$

$f_{Q_1} = f_{Q_2} = f/6$

⇒ Counting:

000 ← initial value

a) Ib 001 $\xrightarrow{\text{decode}}$ (5) CP.

b) Ib 111 $\xrightarrow{\text{decode}}$ (3) CP.

c) Ib 011 $\xrightarrow{\text{decode}}$ (4) CP.

⇒ N-bit Johnson Counter:

→ $2N+1$ Counter

→ Can count $2N$ CLOCK PULSES.

→ Freq. of each FF o/p = $\frac{f}{2N}$

Ex 1 Determine the o/p freq. of a 3-bit Johnson Counter. If the clock freq. is 18 kHz. Initial value of the counter is 010.

Ans:

CLK	Serial input	Q_2 Q_1 Q_0
0	—	0 1 0
1	1	1 0 1
2	0	0 1 0

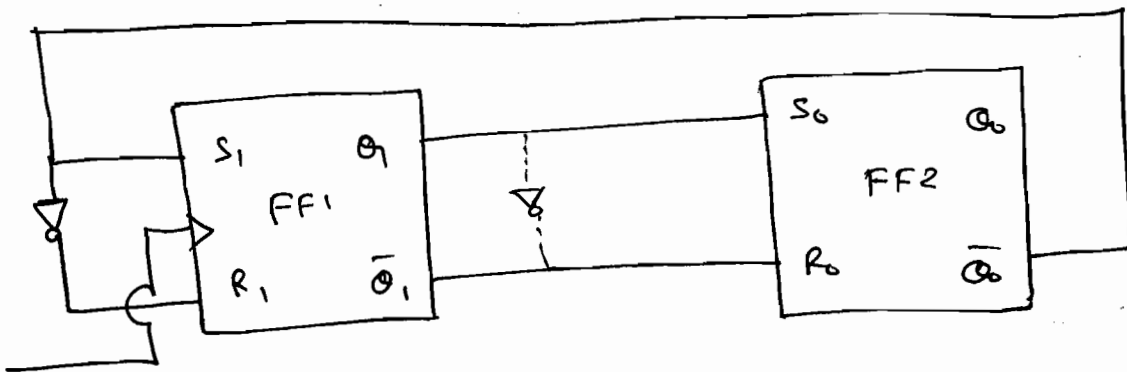
$\therefore$ 2:1 counter.

$$\therefore f_o = f/2$$

$$\therefore f_o = \frac{18}{2}$$

$$\therefore \boxed{f_o = 9 \text{ kHz}}$$

Ex 2 Determine the value of the following clk after the 729 CP?



→ Given FFs are in toggle mode and are 2 FF.

