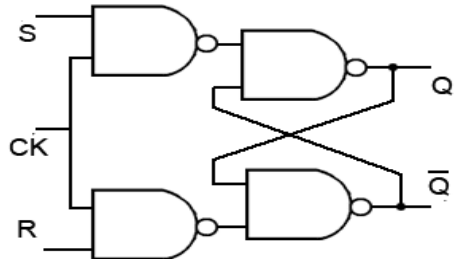
Sequential logic circuits

- The output at any time depends on the present inputs as well as past outputs
- Flip-flop (FF) is the basic building block of sequential circuits

S-R flip-flop:-

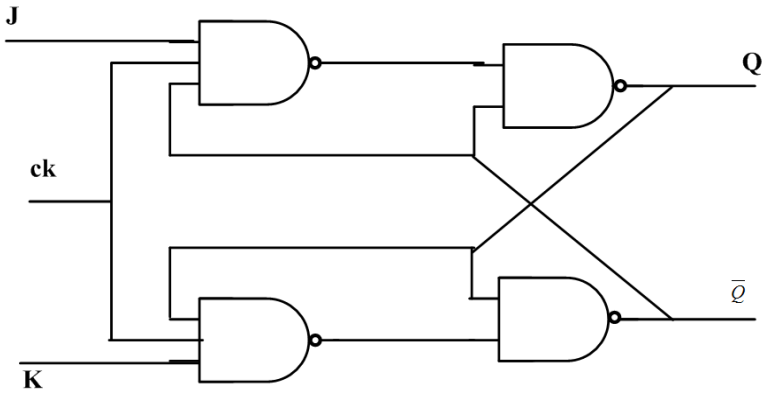


- When ck=0 ➡ the ff remains in the previous state .
- When ck=1, the following truth table is obtained

Q_n = previous state ; Q_{n+1} = present state

S	R	Q_n	Q_{n+1}	
0	0	0	0	Q_n
0	0	1	1	
0	1	0	0	0
0	1	1	0	
1	0	0	1	1
1	0	1	1	
1	1	0	×	
1	1	1	×	

J-K flip flop:-



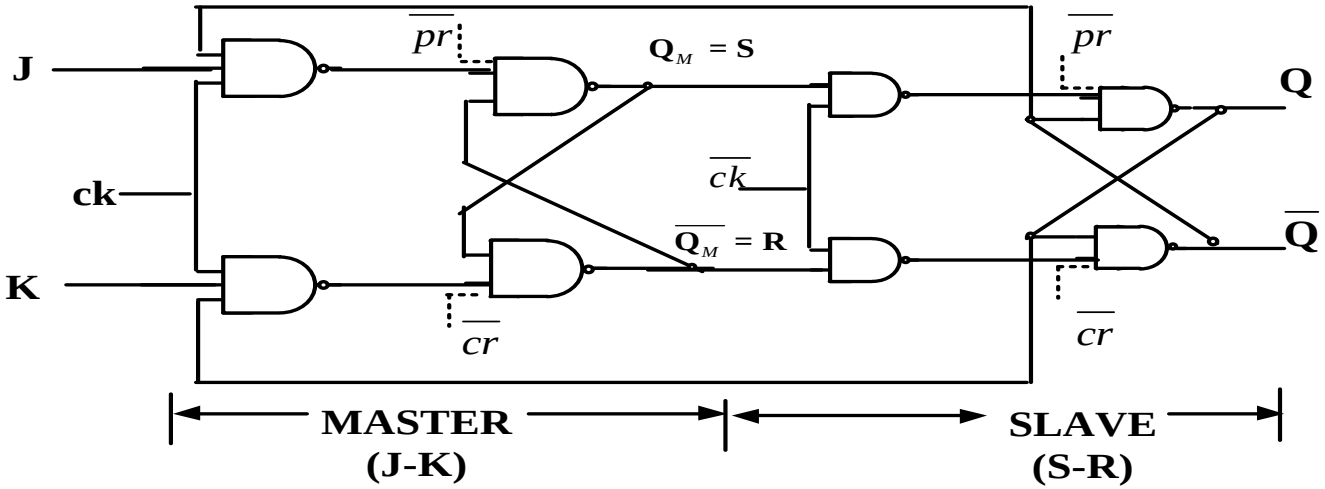
J	K	Q_n	Q_{n+1}	
0	0	0	0	Q_n
0	0	1	1	
0	1	0	0	0
0	1	1	0	
1	0	0	1	1
1	0	1	1	
1	1	0	1	$\overline{Q_n}$
1	1	1	0	

Race-around condition:-

If $J=1;\ K=1$ and ck=1 the output changes for every ΔT sec:

Where ΔT is the propagation delay of JK FF. To avoid the race-around condition, master- slave FF is used .

Master- slave FF:-

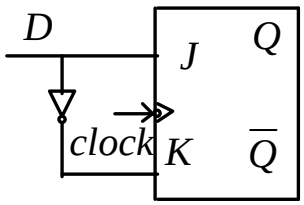


- Master-slave FF is an edge triggered FF.

Preset and clear operations:-

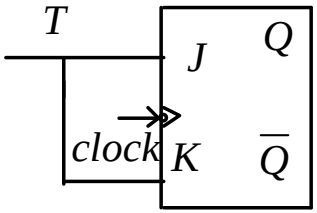
- Used to establish initial states of the FF.
- If $\overline{cr} = 0$; $\overline{pr} = 1$ ➡ Q=0 (clear operation)
- If $\overline{cr} = 1$; $\overline{pr} = 0$ ➡ Q=1 (Preset ,,)
- If $\overline{cr} = \overline{pr} = 1$ ➡ Normal operation

D-flip flop



D	Q_n	Q_{n+1}
0	0	0
0	1	0
1	0	1
1	1	1

T-flip flop



T	Q_n	Q_{n+1}	
0	0	0	Q_n
0	1	1	
1	0	1	$\overline{Q_n}$
1	1	0	