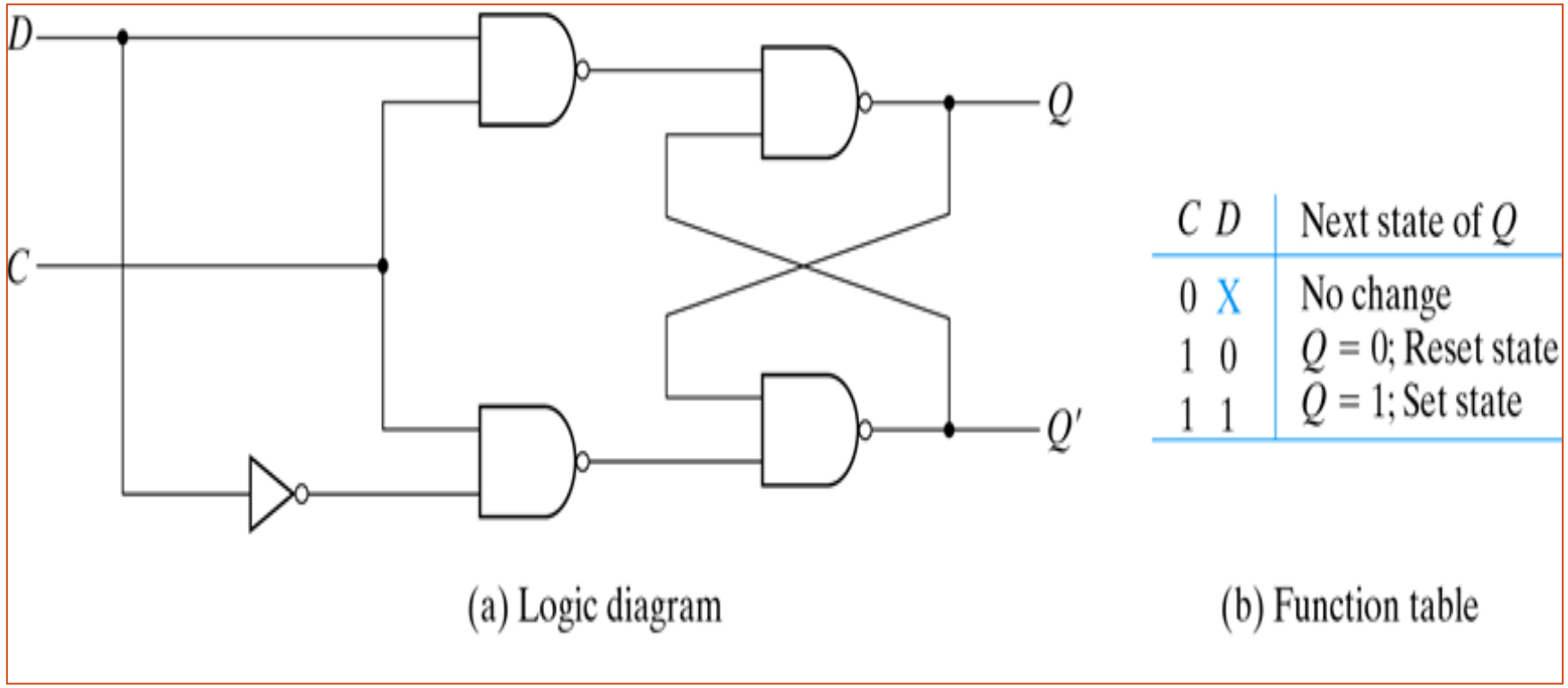
D-JK-T Flip Flop

PRESENTED BY NABANITA DAS

D Flip-Flop

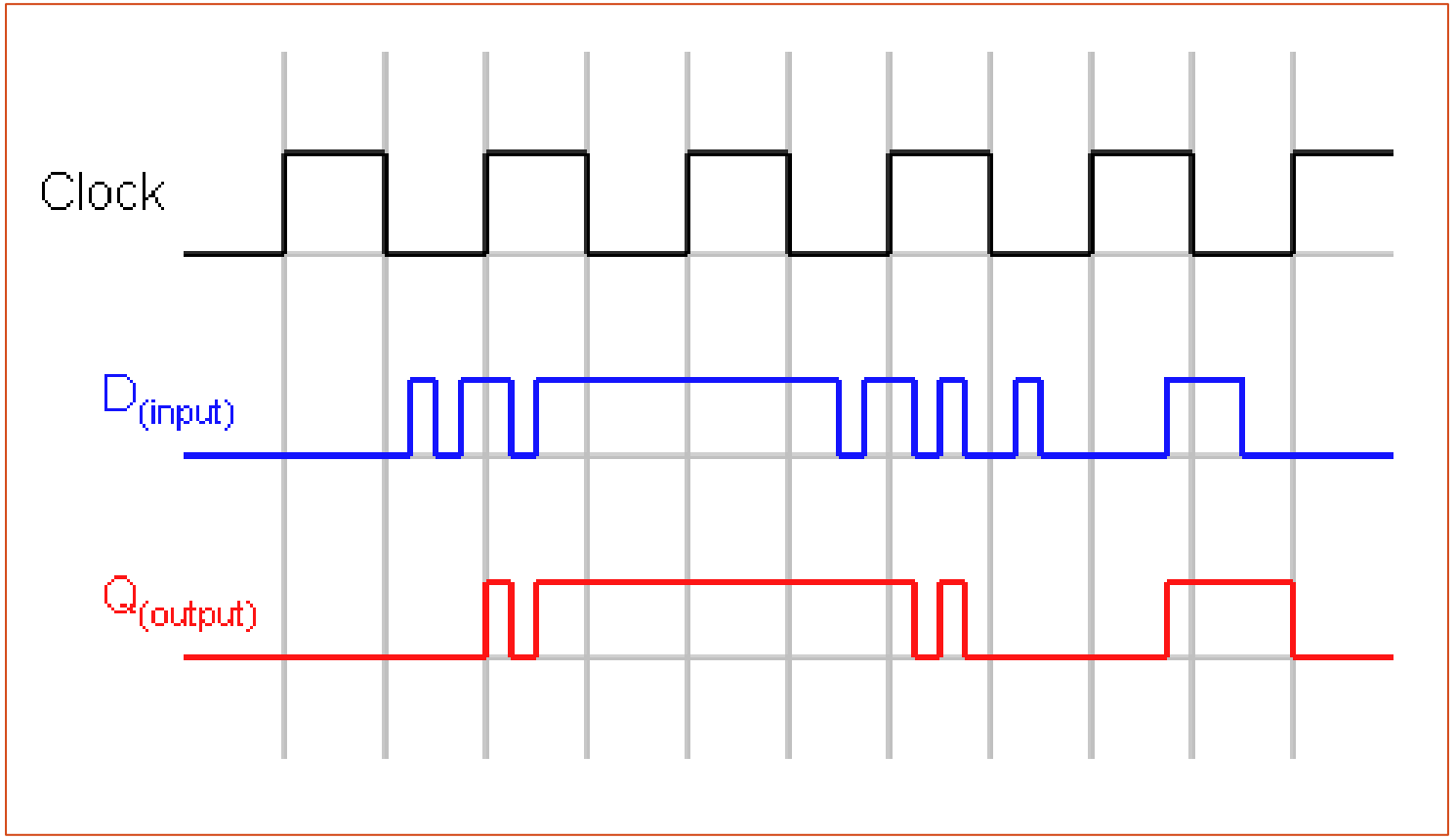


(a) Logic diagram

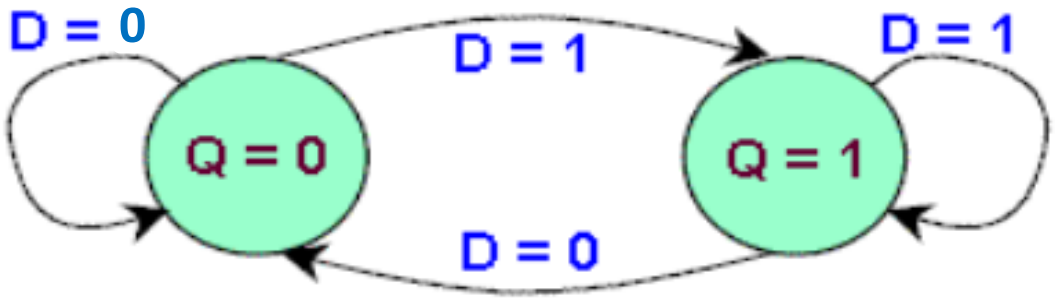
C	D	Next state of Q
0	X	No change
1	0	Q = 0; Reset state
1	1	Q = 1; Set state

(b) Function table

Timing Diagram of D Flip Flop



State Transition Diagram of D Flip Flop



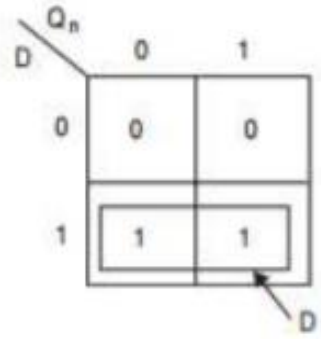
Clk	D	Q	Q'	State
0	0	Q	Q'	No change in state
1	0	0	1	Resets Q to 0
1	1	1	1	Sets Q to 1

D Flip-Flop

Characteristic Table of an D Flip Flop.

Flip-flop inputs	*Present output*	*Next output*
D	Q_n	Q_{n+1}
0	0	0
0	1	0
1	0	1
1	1	1

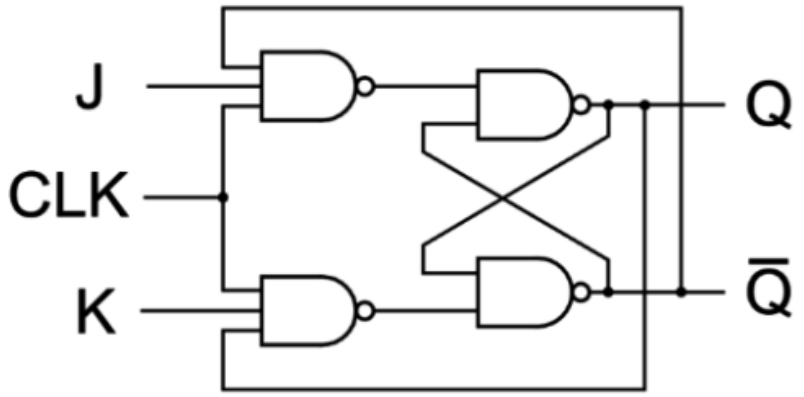
Now we will find out the characteristic equation of the D flip-flop from the characteristic table with the help of the Karnaugh map:-



Hence, the characteristic equation of a D flip-flop is

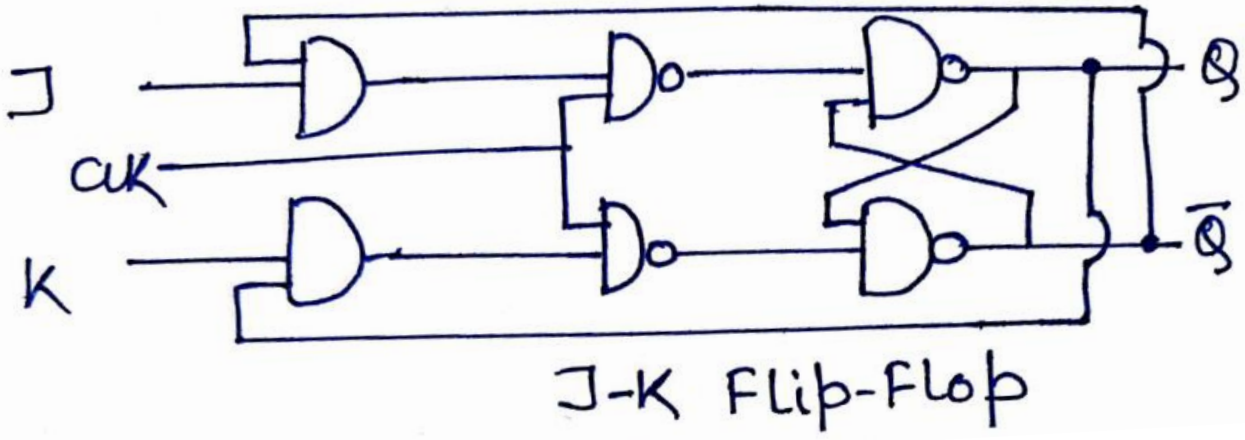
$$Q_{n+1} = D$$

JK Flip-Flop



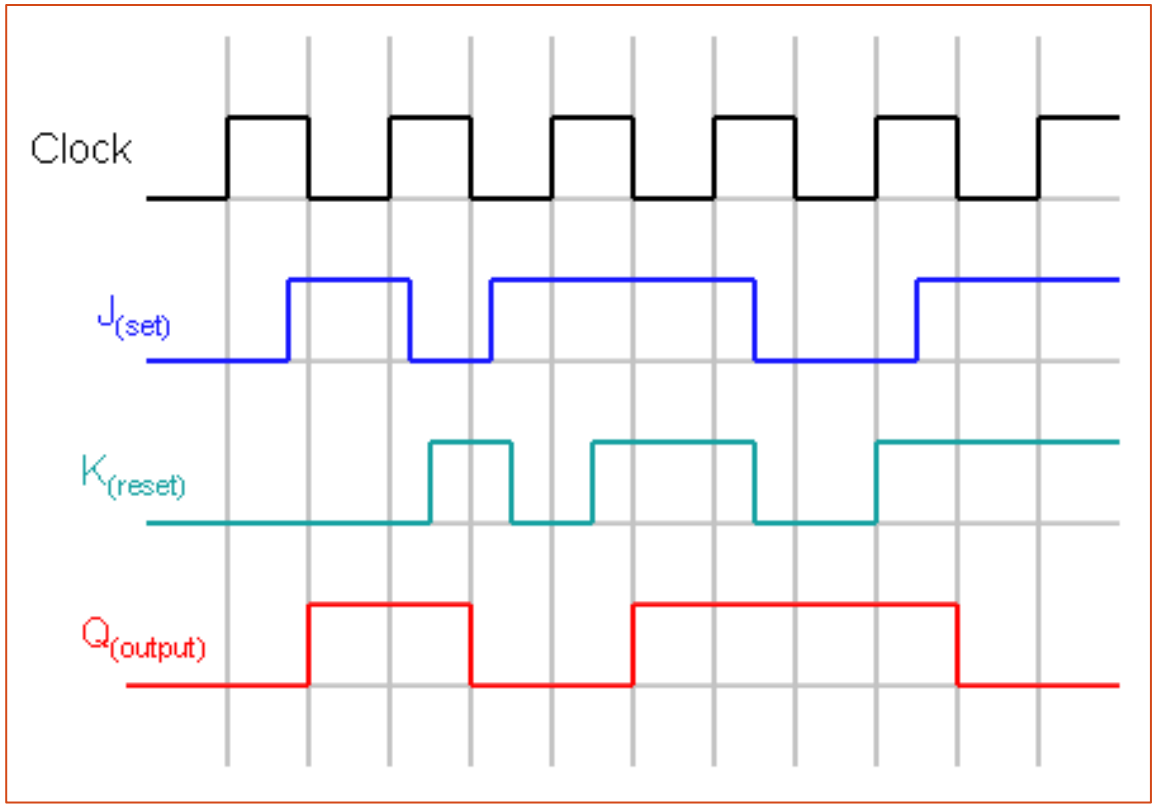
JK flip – flop is named after Jack Kilby.

A JK flip – flop is a modification of SR flip – flop. In this the J input is similar to the set input of SR flip – flop and the K input is similar to the reset input of SR flip – flop. The condition J = K = 1 which is not allowed in SR flip – flop (S = R = 1) is interpreted as a toggle command.

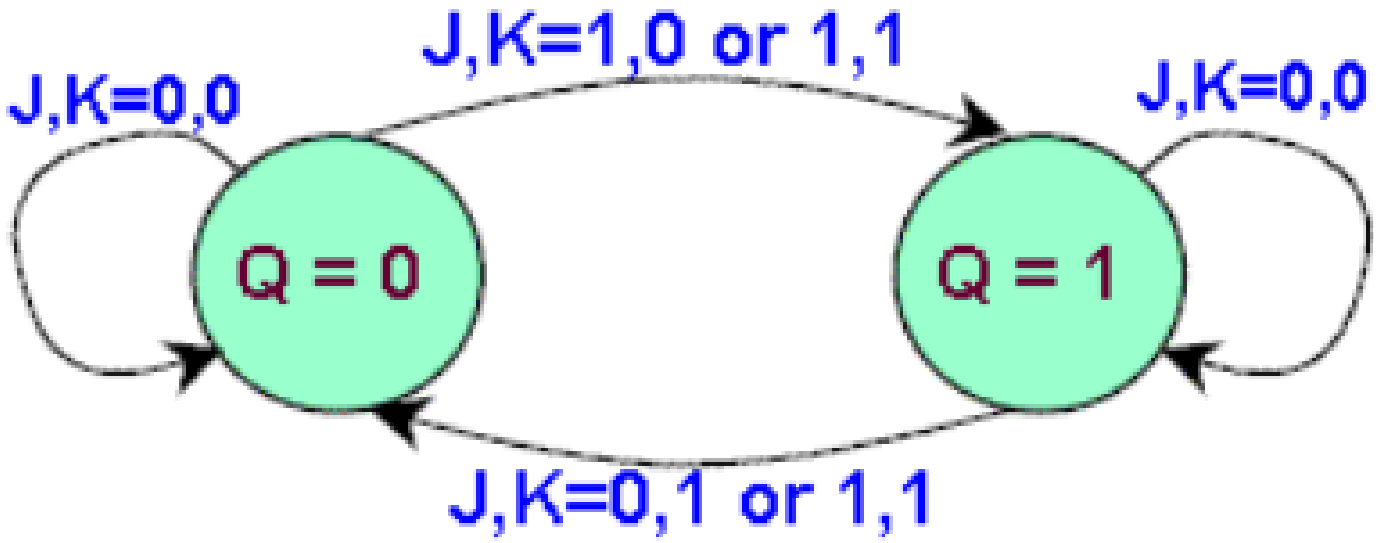


Clk	J	K	Q	Q'	State
1	0	0	Q	Q'	No change in state
1	0	1	0	1	Resets Q to 0
1	1	0	1	0	Sets Q to 1
1	1	1	-	-	Toggles

Timing Diagram of JK Flip Flop



State Transition Diagram of JK Flip-Flop

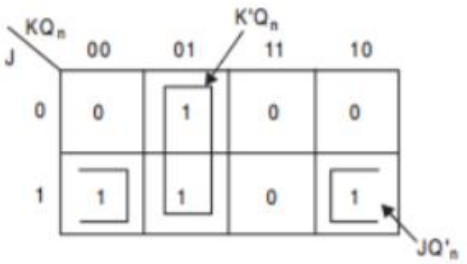


Clk	J	K	Q	Q'	State
1	0	0	Q	Q'	No change in state
1	0	1	0	1	Resets Q to 0
1	1	0	1	0	Sets Q to 1
1	1	1	-	-	Toggles

Characteristic Equation of JK Flip-Flop

As we have already discussed the characteristic equation of an S-R flip-flop, we can similarly find out the characteristic equation of a J-K flip-flop. The characteristic table of a J-K flip-flop is given in the table below. From the characteristic table we have to find out the characteristic equation of the J-K flip-flop.

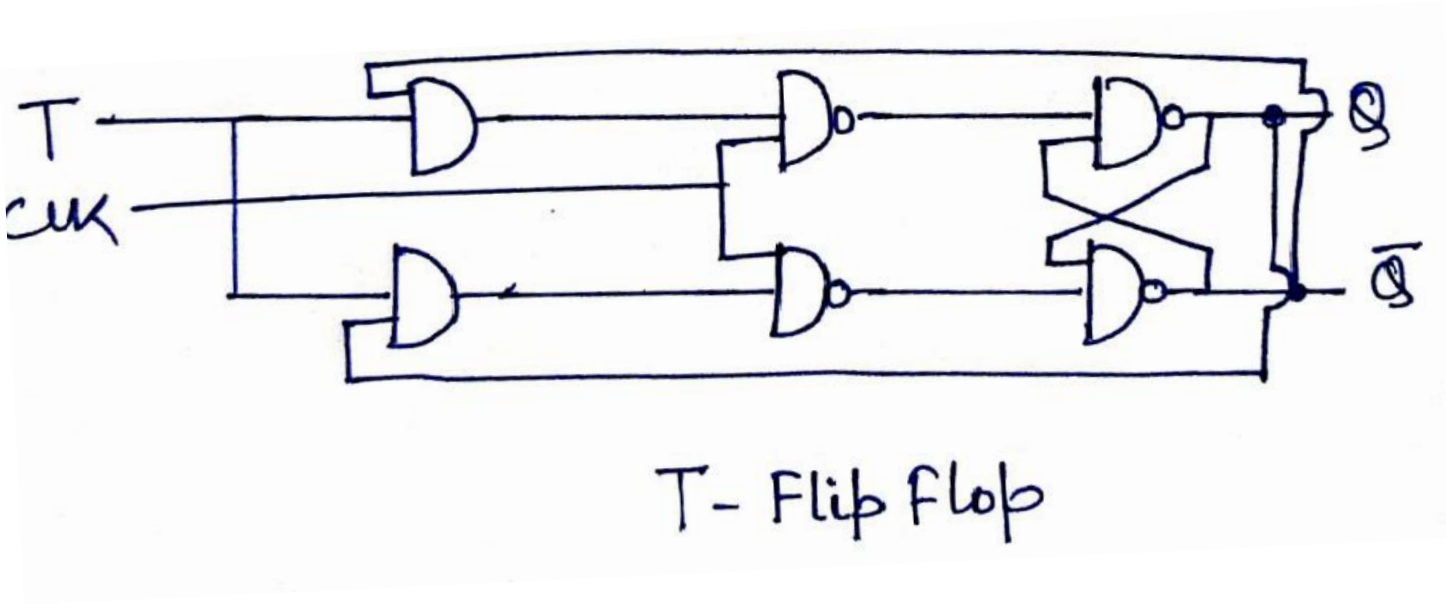
Flip-flop inputs		*Present output*	*Next output*
J	*K*	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0



From the Karnaugh map, we obtain $\mathbf{Q_{n+1} = JQ'_n + K'Q_n}$.
Hence, the characteristic equation of a J-K flip-flop is

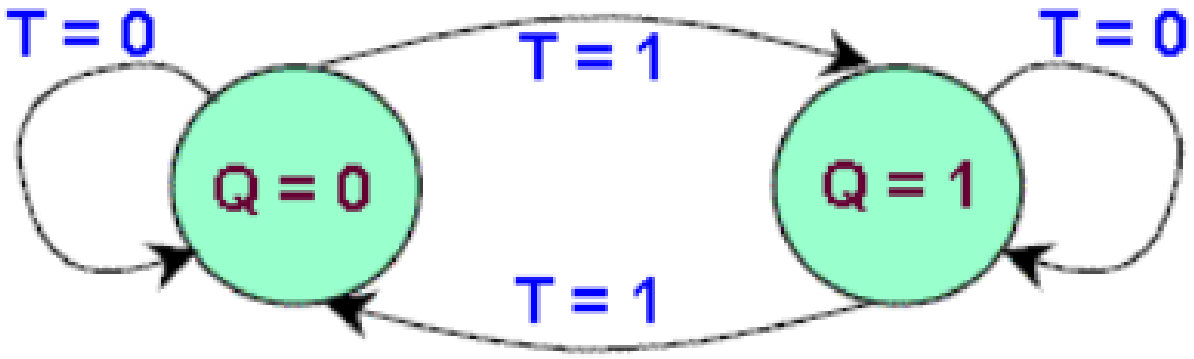
$$\mathbf{Q_{n+1} = JQ'_n + K'Q_n}$$

T (Toggle) flip-flop



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

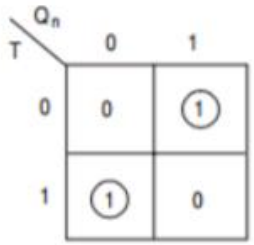
State Transition Diagram of T Flip-Flop



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

Characteristic Equation of T Flip-Flop

Now we will find out the characteristic equation of the T flip-flop from the characteristic table with the help of the Karnaugh map below:-



Flip-flop inputs	*Present output*	*Next output*
T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

From the Karnaugh map, the Boolean expression of Q_{n+1} is derived as $Q_{n+1} = TQ'_n + T'Q_n$. Hence, the characteristic equation of a T flip-flop is

$$Q_{n+1} = TQ'_n + T'Q_n$$