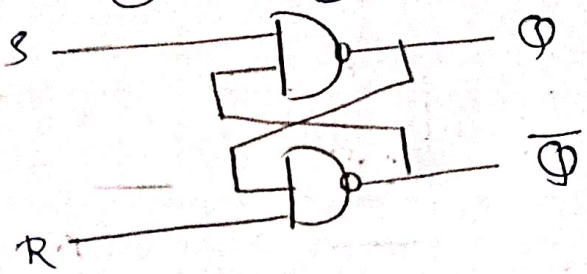
SR Latch.

Block diagram

logic diagram



Truth table.

S	R	Q(t+1)	State
0	0	?(1)	forbidden
0	1	1	set
1	0	0	Reset
1	1	Q(t)	NC

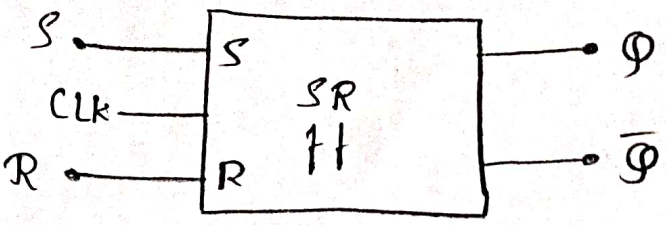
→ Both o/p remains same

→ stays at previous state.

Characteristic table.

S	R	Q(t)	Q(t+1)	
0	0	0	1	} Forbidden state
0	0	1	1	
0	1	0	1	} set state
0	1	1	1	
1	0	0	0	} Reset state
1	0	1	0	
1	1	0	0	} No change state.
1	1	1	1	

① SR ff.

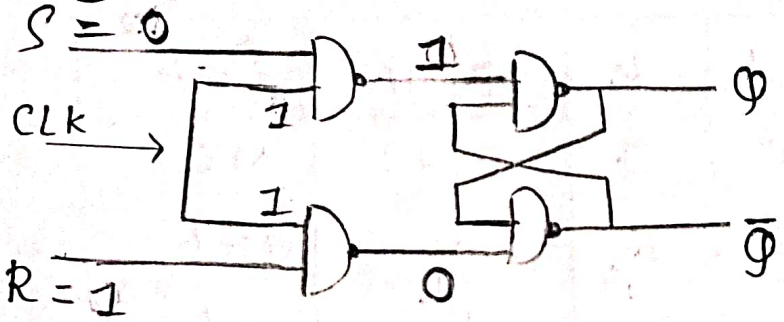


Block diagram.

Truth table

CLK	S	R	Q(t+1)	State
0	x	x	Q(t)	previous state.
1	0	0	Q(t)	NC
1	0	1	0	Reset
1	1	0	1	Reset
1	1	1	x	Forbidden

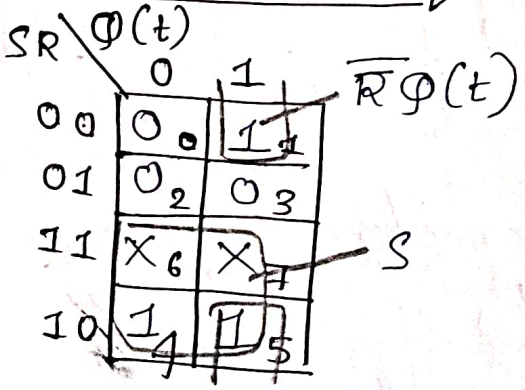
Logic Circuit diagram



Charaterstics table for SR ff.

S	R	Q(t)	Q(t+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	x
1	1	1	x

Characteristic Eqtn.

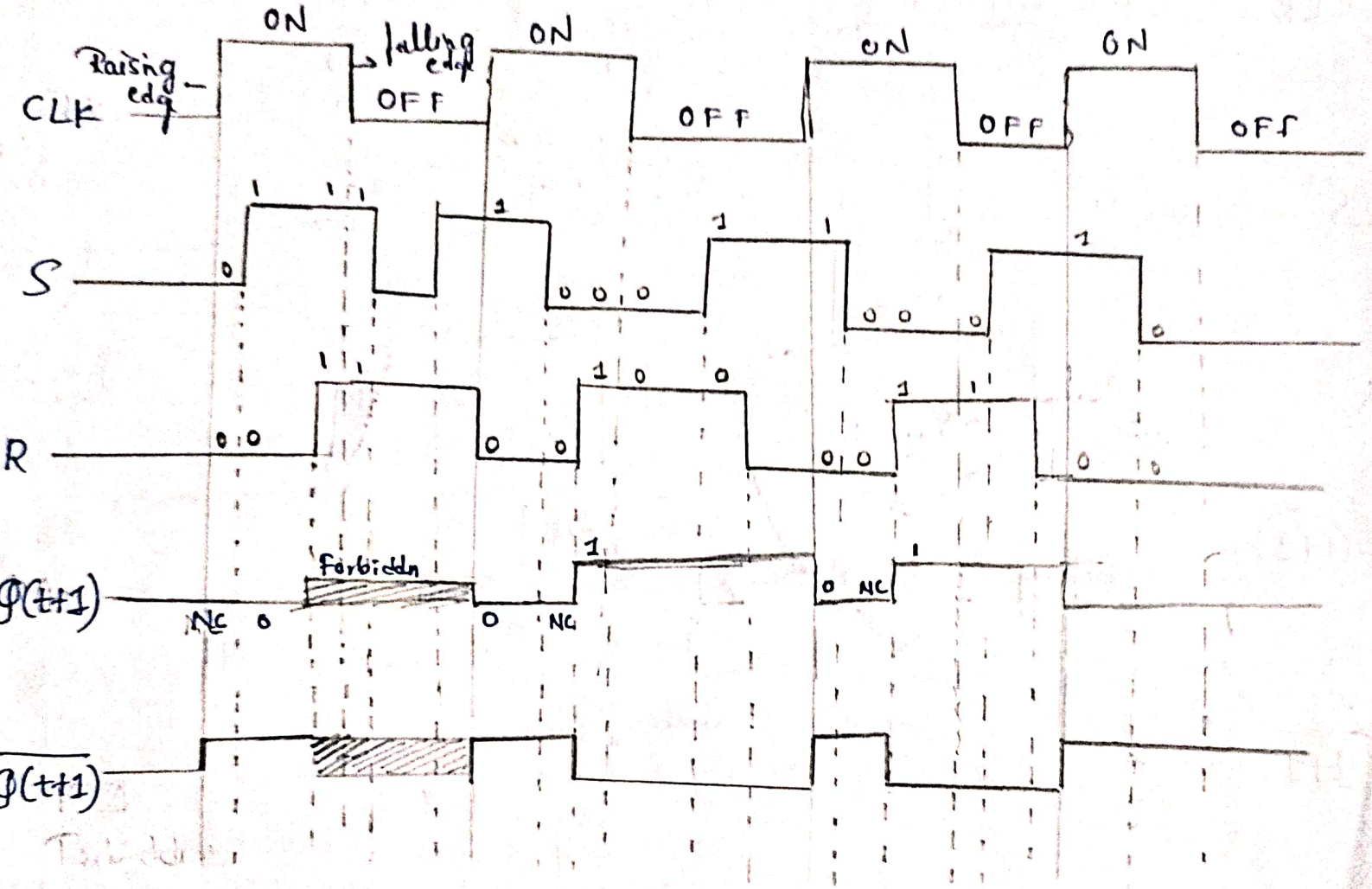


$Q(t+1) = S + \bar{R}Q(t)$ //

Excitation table

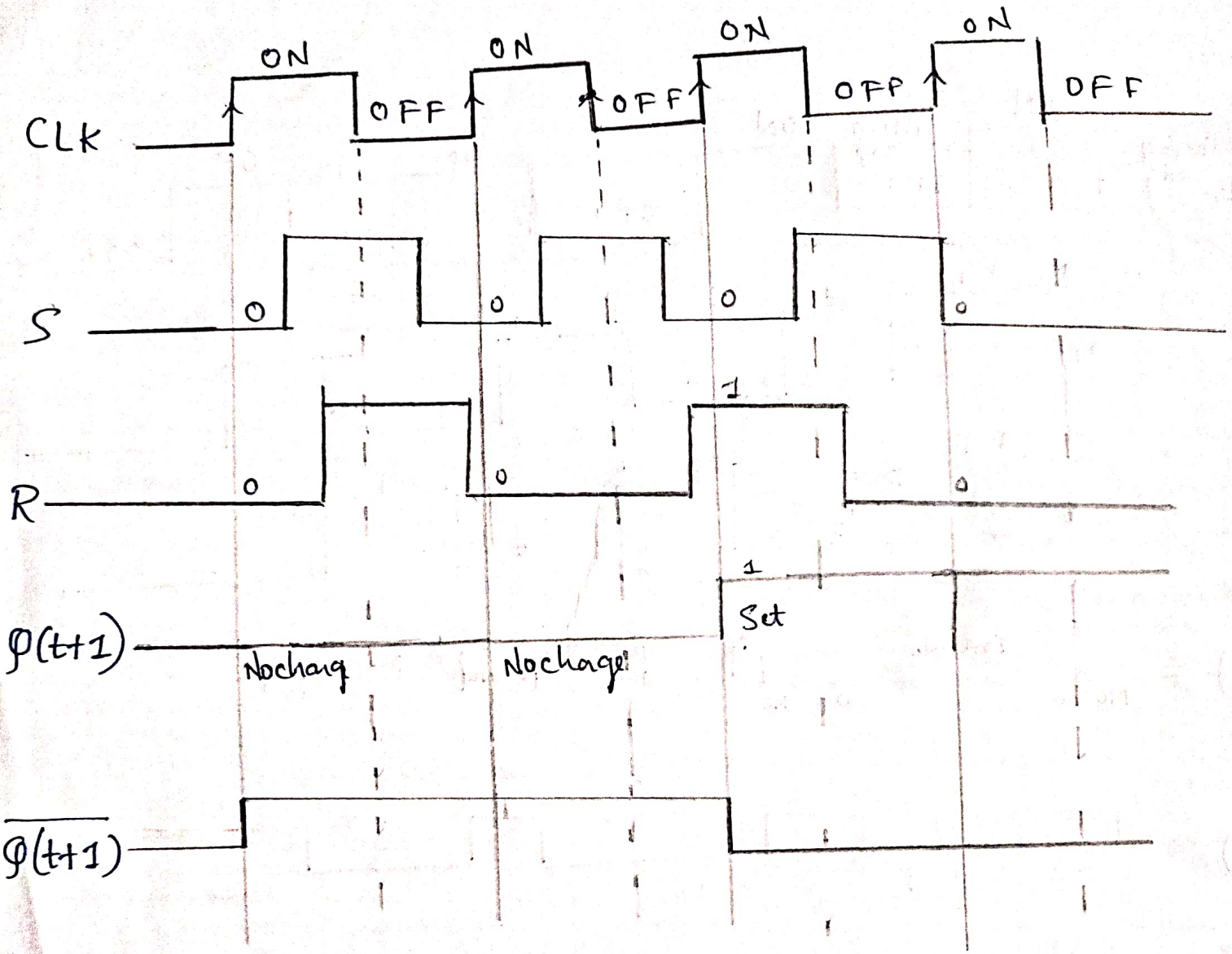
$Q(t)$	$Q(t+1)$	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

SR-Waveform (Level Triggered).



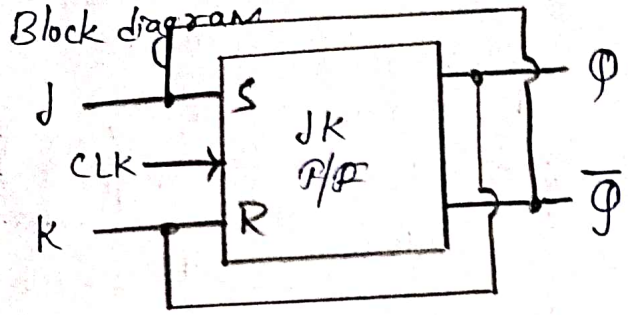
forbidden.

S R Wave form (Edge Triggered)

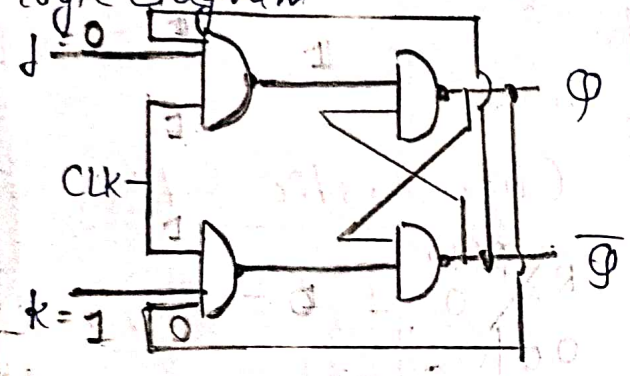


JK flip flop:

Block diagram



logic diagram



Truth table:

J	K	Q(t+1)	State
0	0	Q(t)	NC
0	1	0	Reset
1	0	1	Set
1	1	$\overline{Q(t)}$	toggle

Characteristic table:

J	K	Q(t)	Q(t+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

Characteristic equation:

JK \ Q(t)	0	1
00	0_0	1_1
01	0_2	0_3
11	1_6	0_7
10	1_4	1_5

$J\overline{Q(t)}$

$\overline{K}Q(t)$

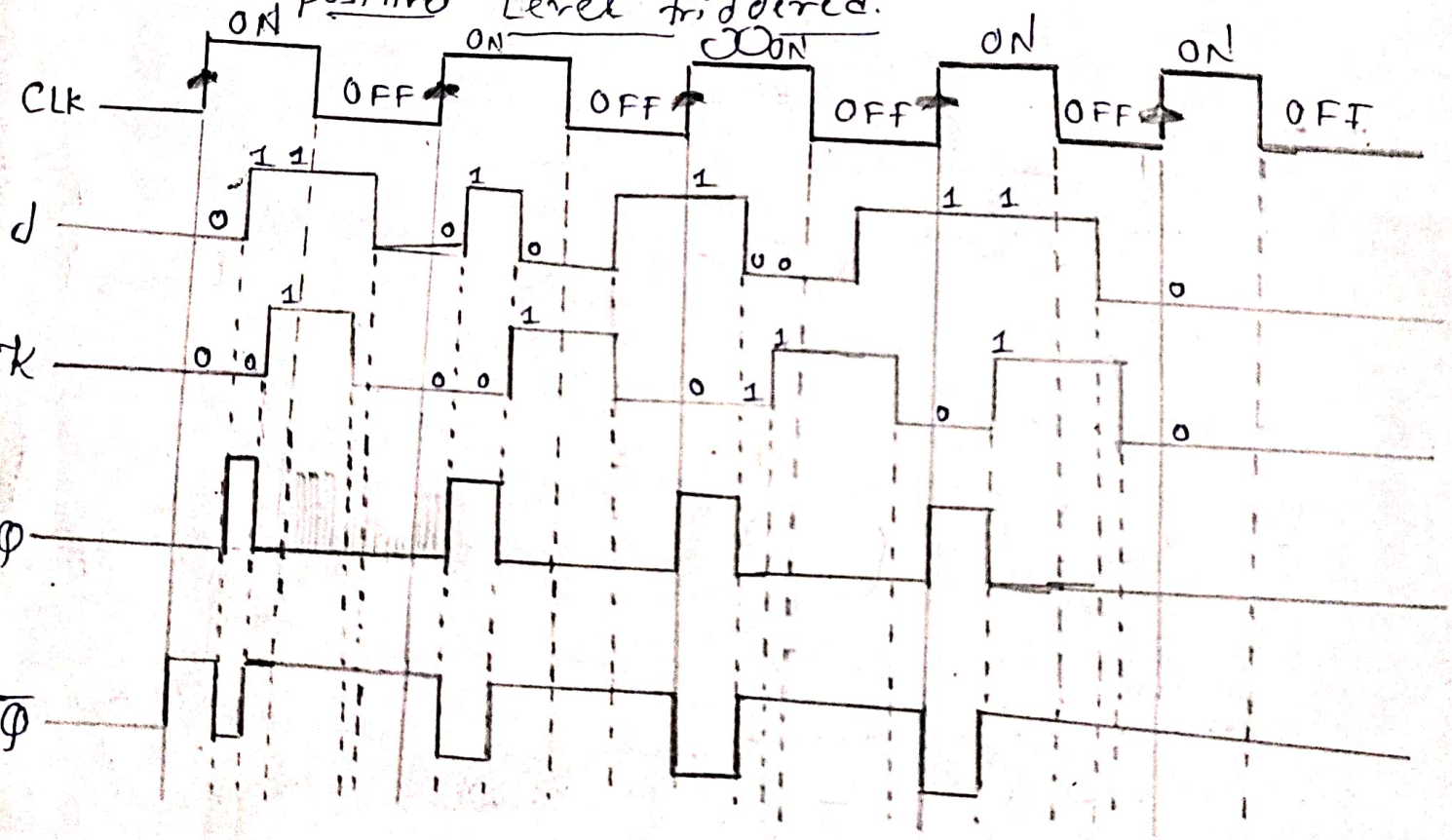
$$Q(t+1) = J\overline{Q(t)} + \overline{K}Q(t)$$

Excitation table.

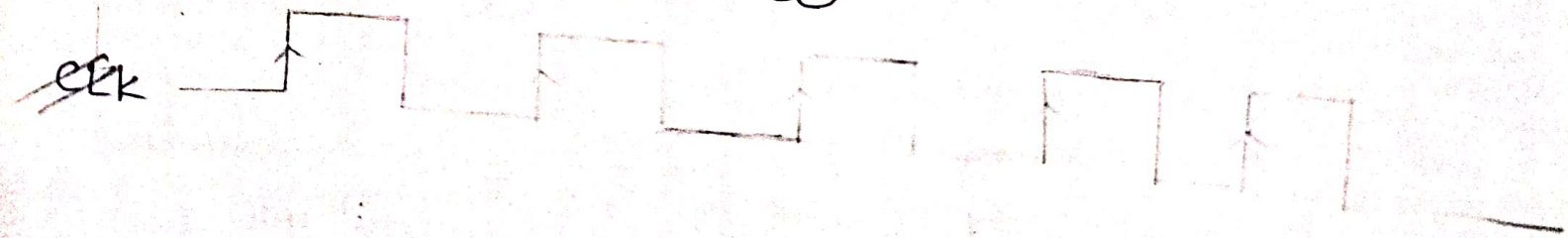
Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Waveforms.

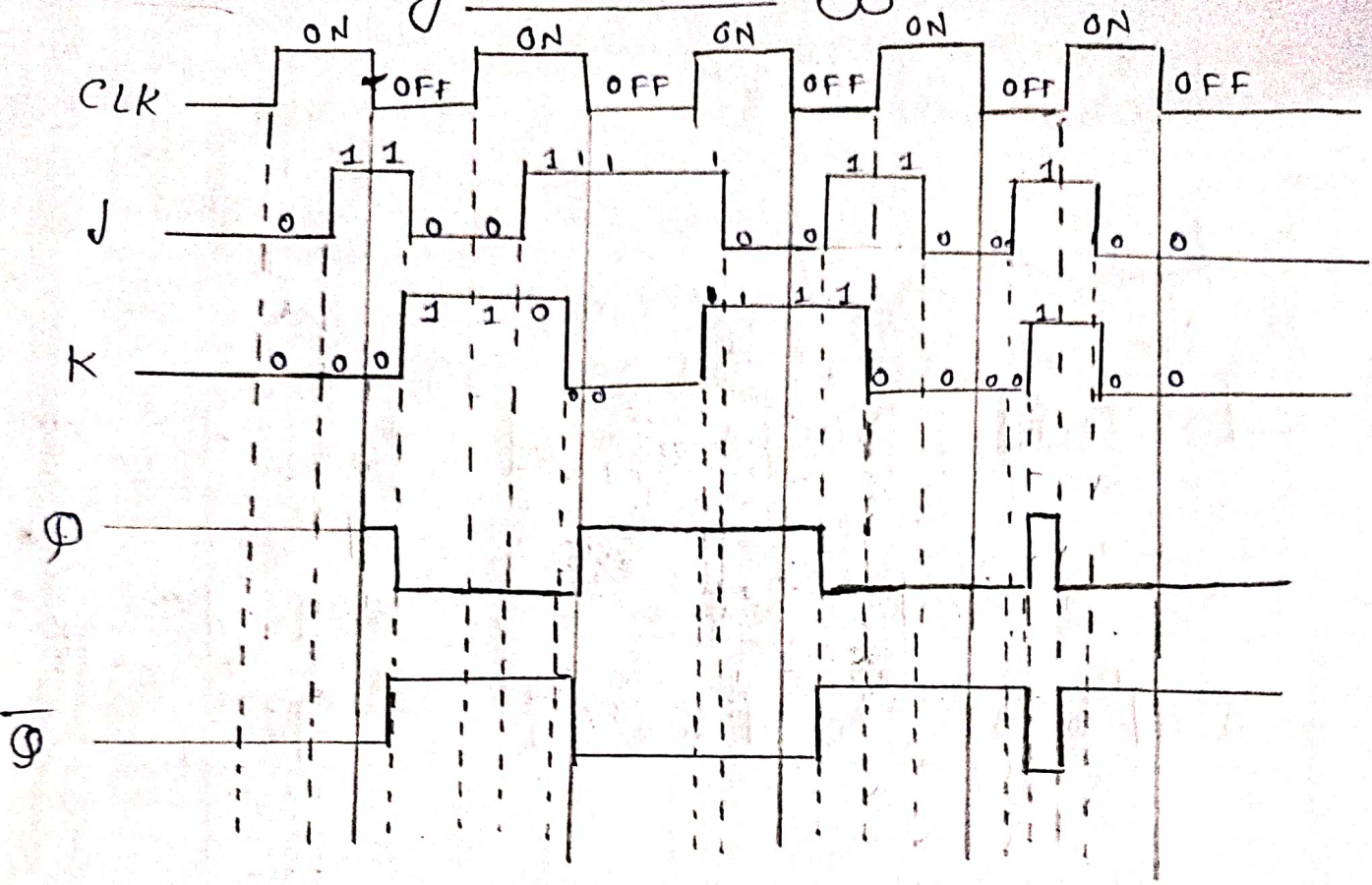
positive Level triggered.



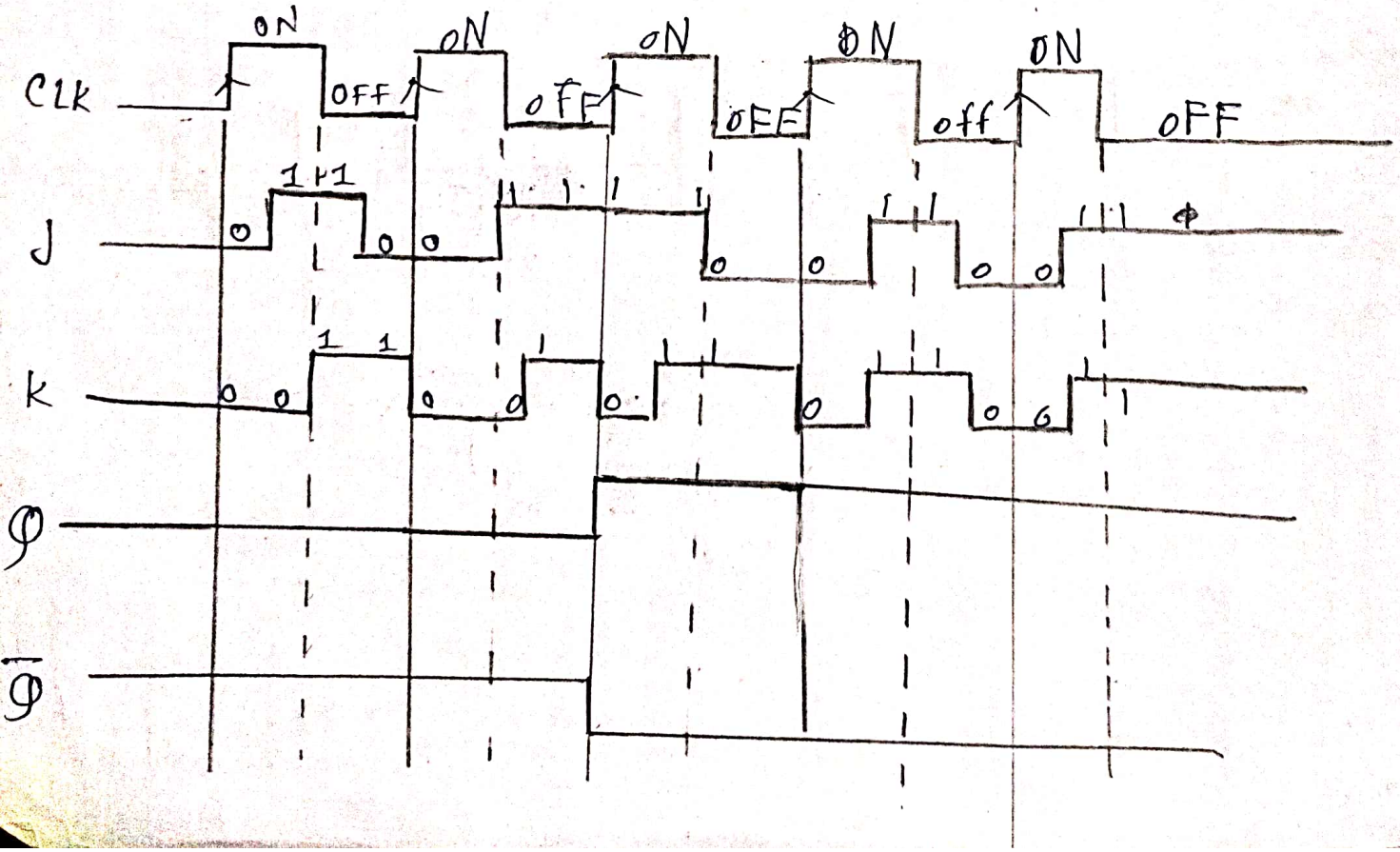
positive edge triggered

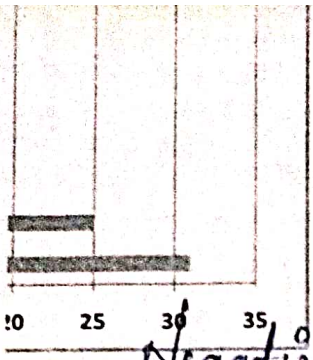


Negative level triggered

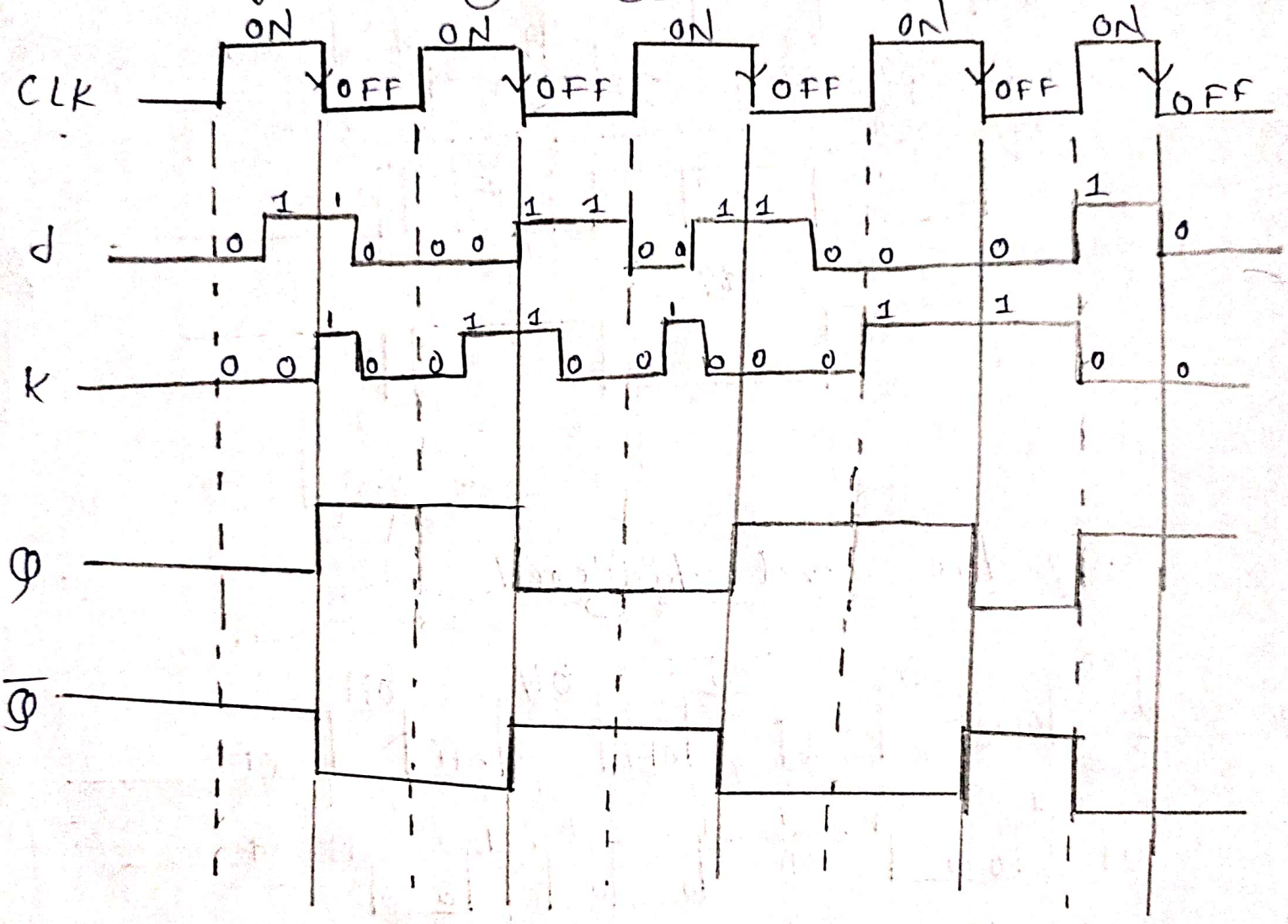


positive level triggered



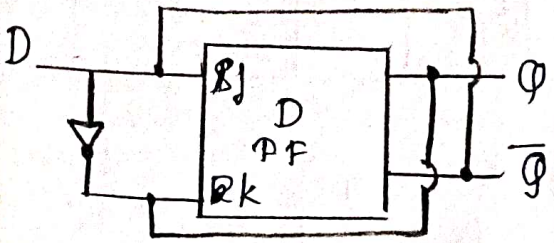


Negative Edge triggered.

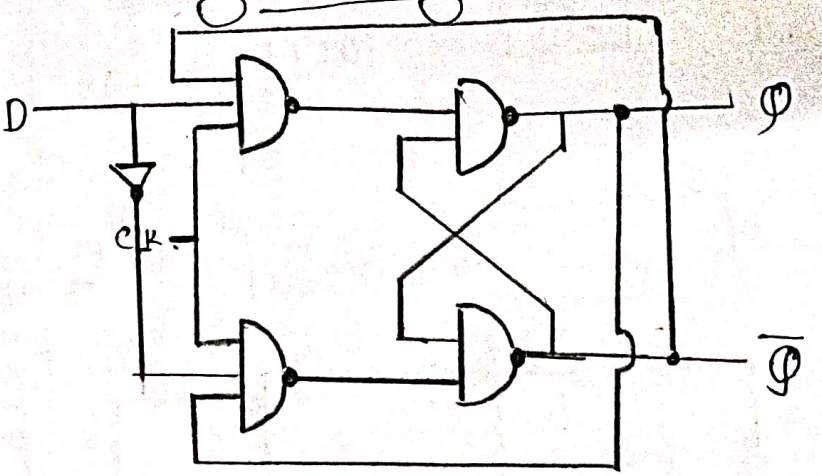


D - Flip flop

Block Diadram.



Logic Diadram



Truth table.

Clk	D	Q(t+1)
↓	X	Q(t)
↑	0	0
↑	1	1

Characterstic table.

D	Q(t)	Q(t+1)
0	0	0
0	1	0
1	0	1
1	1	1

Characterstic equation.

D \ Q(t)	0	1
0	0_0	0_1
1	1_2	1_3

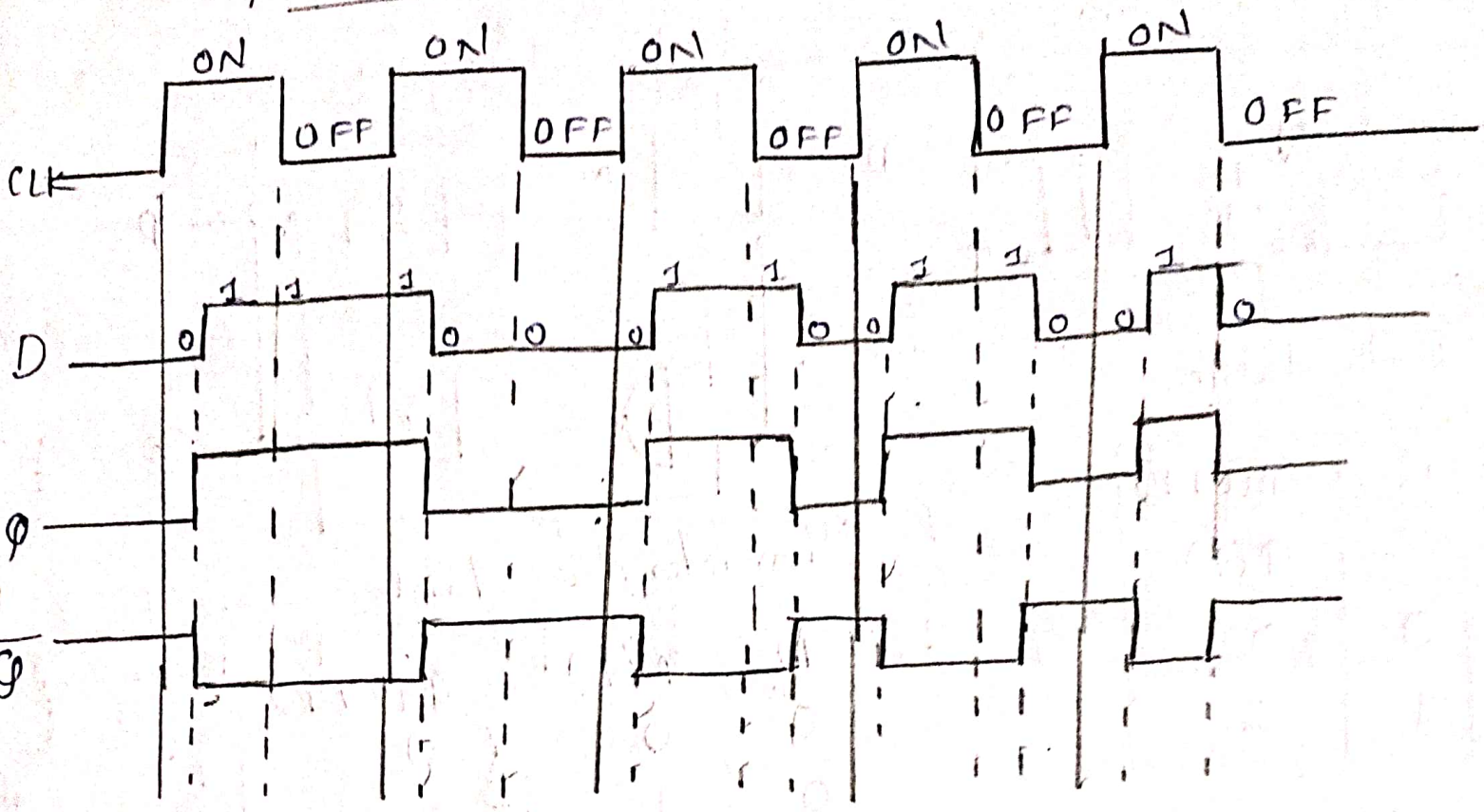
D

$$Q(t+1) = D$$

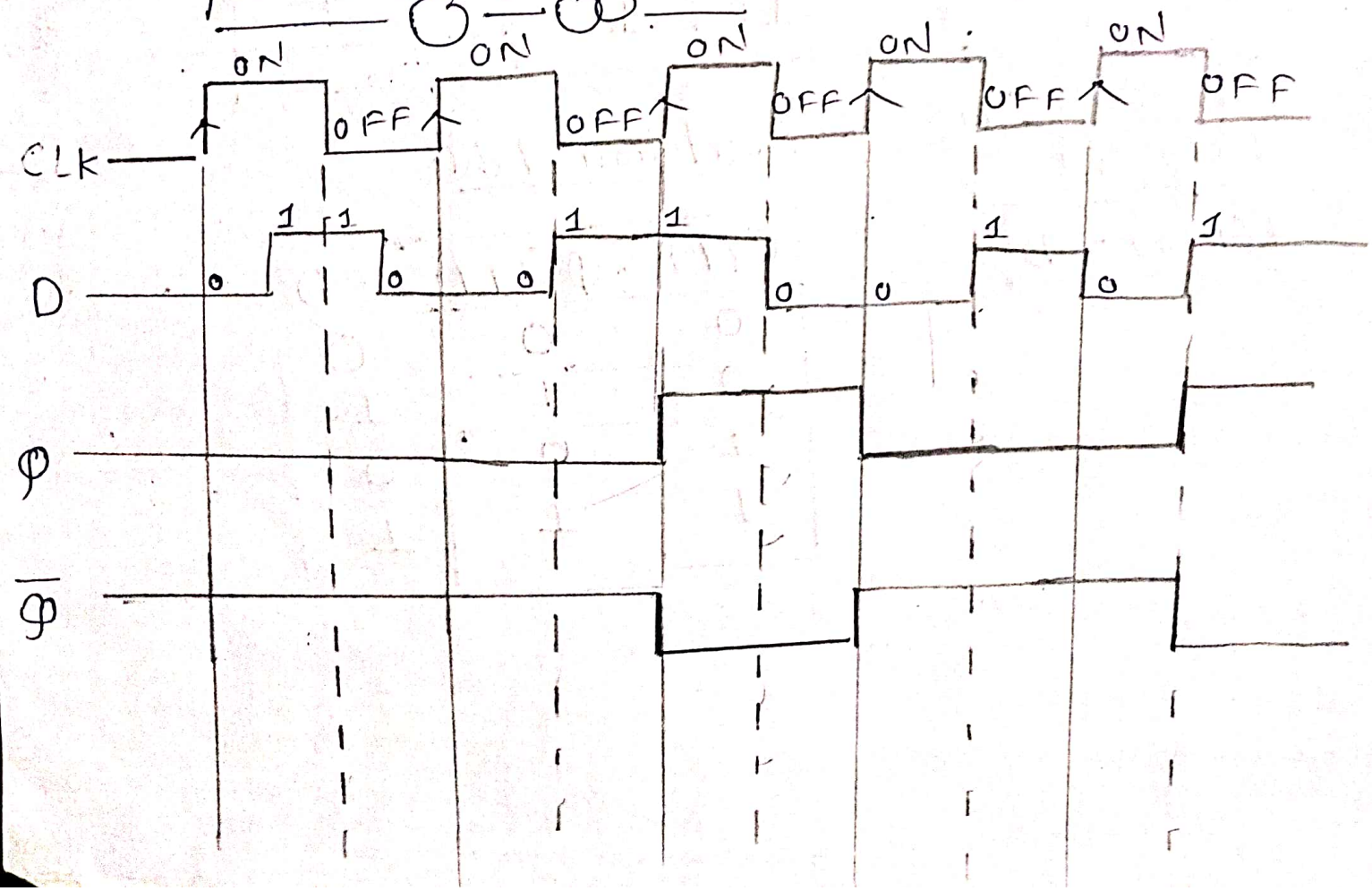
Excitation table.

Q(t)	Q(t+1)	D
0	0	0
0	1	1
1	0	0
1	1	1

positive level triggered

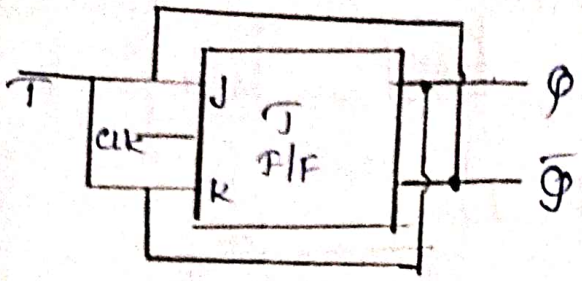


positive Edge triggered.

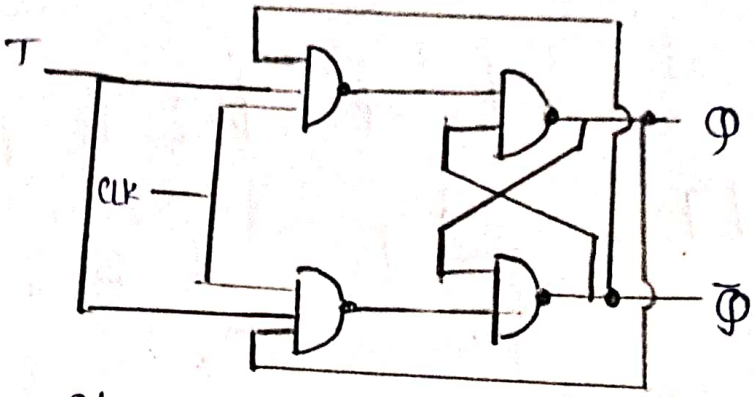


T flip flop

Block Diagram



Logic Diagram



Truth table

CLK	T	Q(t+1)
↓	x	Q(t)
↑	0	Q(t)
↑	1	$\overline{Q(t)}$

Characteristic table

T	Q(t)	Q(t+1)
0	0	0
0	1	1
1	0	1
1	1	0

Characteristic equation

T \ Q(t)	0	1
0	0_0	1_1
1	1_2	0_3

$\bar{T}Q(t)$

$T\overline{Q(t)}$

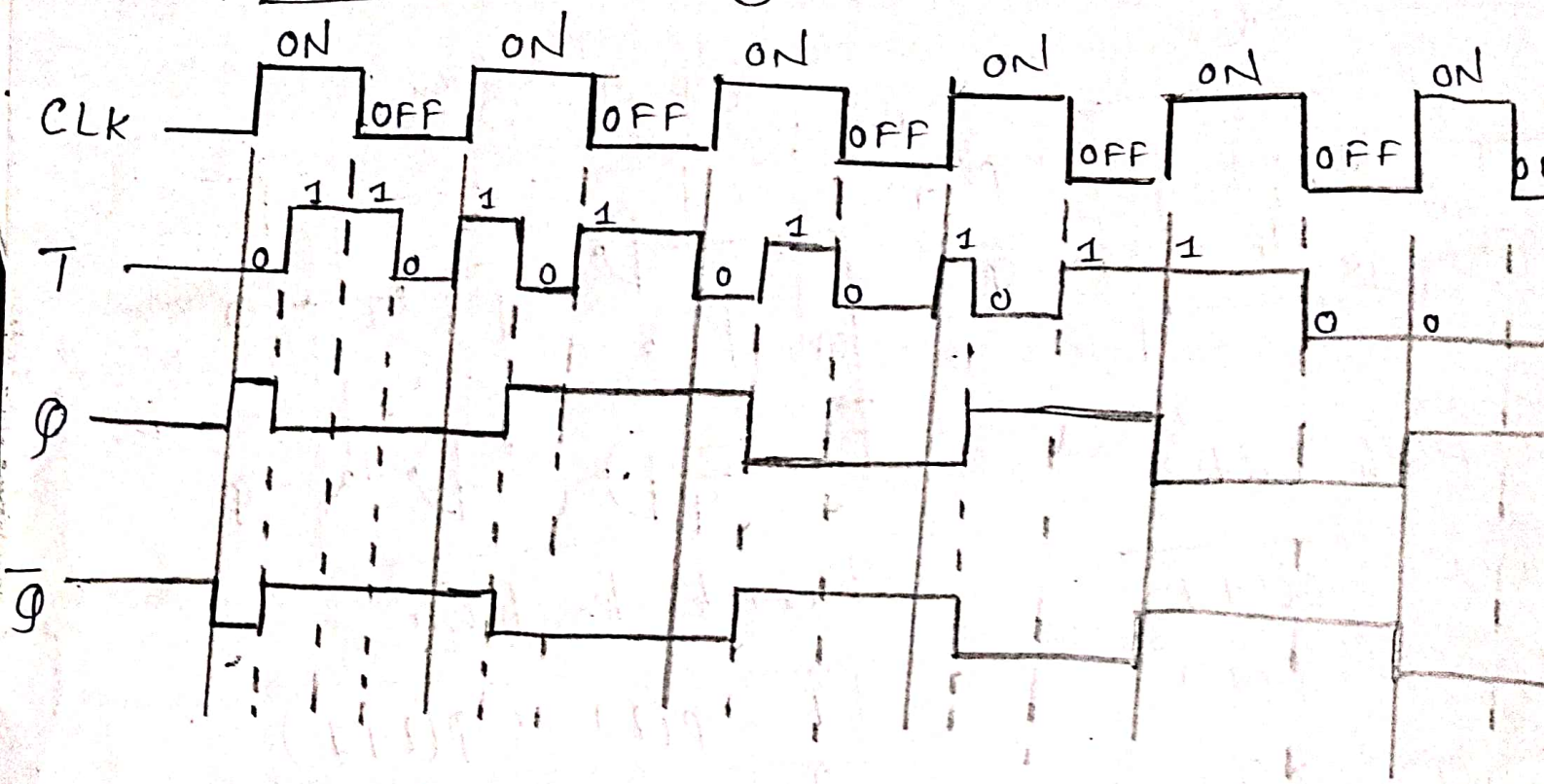
$$Q(t+1) = \bar{T}Q(t) + T\overline{Q(t)}$$

Excitation Table

Q(t)	Q(t+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

Waveforms.

positive level triggered.



positive Edge trigger