gradeup

Prep Smart. Score Better.

Computer Organization and Architecture

Flip flops

ABOUT ME : MURALIKRISHNA BUKKASAMUDRAM

- M.Tech with 20 years of Experience in Teaching GATE and Engineering colleges
- IIT NPTEL Course topper in Theory of computation with 96 %
- IGIP Certified (Certification on International Engineering educator)
- GATE Qualified
- Trained more than 50 Thousand students across the country
- Area of Expertise : TOC,OS,COA,CN,DLD

Flip flops

Flip Flop

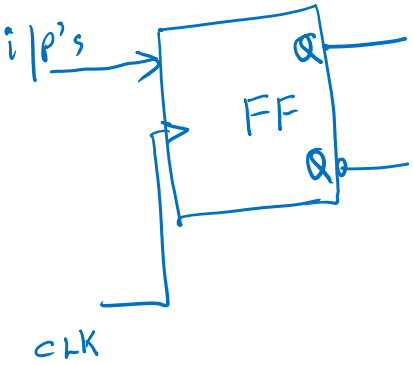
Flip Flop is a binary storage cell.

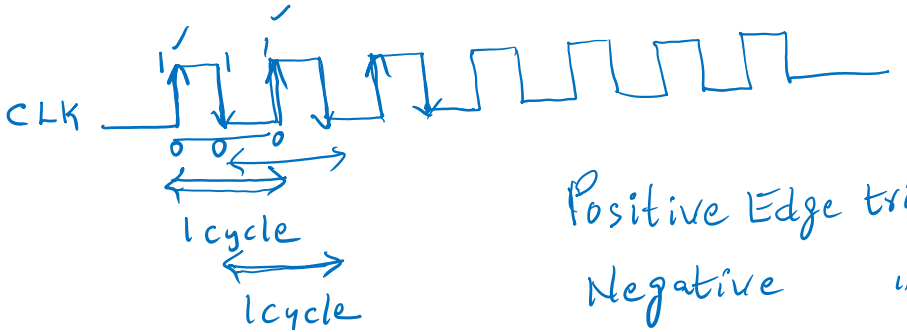
Capable of storing 1-bits of info.

0 – Low (0 volts)
1 – High (5 volts)

Q(t) — Before Applying inputs

Q(t+1) — After applying inputs





Positive Edge triggered

Negative "

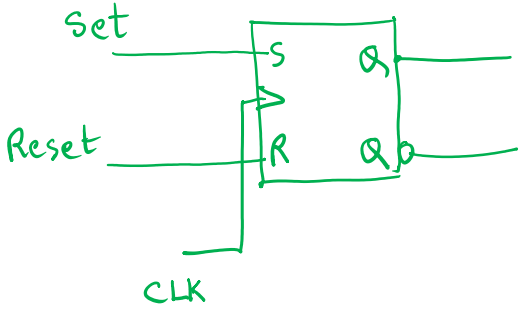
Flip flops

Types of flip flops

(1) SR flip flop
(2) D - flip flop
(3) T - flip flop
(4) JK - flip flop.

0 → 0

SR flip flop



characteristic Table

CLK	S	R	Q(t+1)
0	X	X	—
↑	0	0	Q(t) No change
↑	0	1	0 clear to zero
↑	1	0	1 set to 1
↑	1	1	Indeterminent

Excitation Table

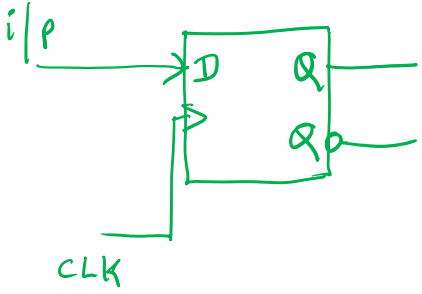
Q(t)	Q(t+1)	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

S	R
0	0
0	1
0	X

S	R
0	0
X	0

Flip flops

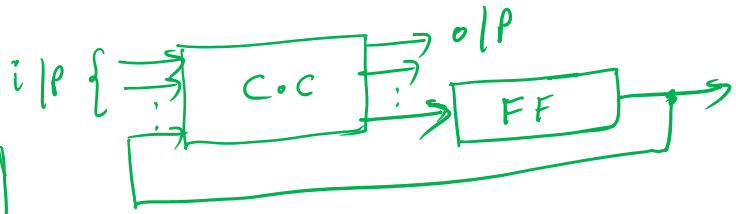
D - Flip Flop.



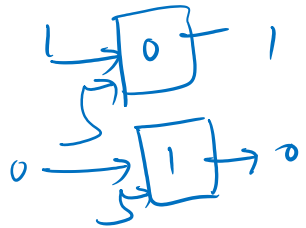
Characteristic Table

CLK	D	Q(t+1)
0	X	—
↑	0	0
↑	1	1

Sequential Circuit



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

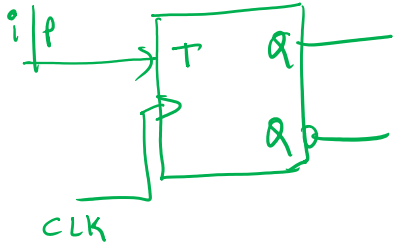


Excitation Table

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

Flip flops

T- Flip Flop



characteristic Table

CLK	T	Q(t+1)	
0	X	—	
↑	0	Q(t)	No change
↑	1	Q'(t)	complement

Toggle

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

Excitation Table

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

$Q(t+1) = Q(t) \oplus T$

$0 \oplus 0 = 0$

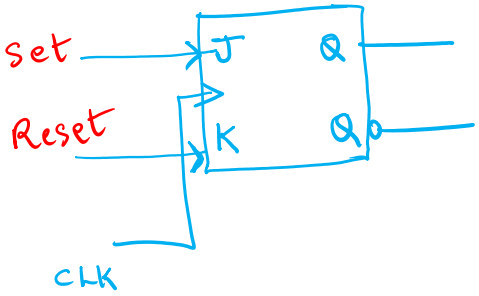
$1 \oplus 0 = 1$

$1 \oplus 1 = 0$

$0 \oplus 1 = 1$

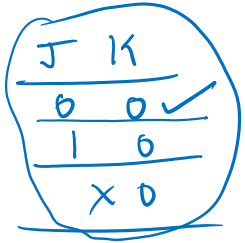
Flip flops

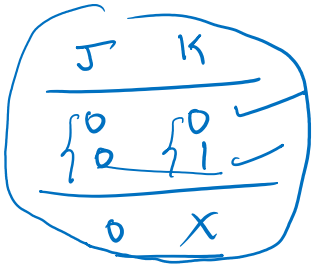
JK – flip flop.

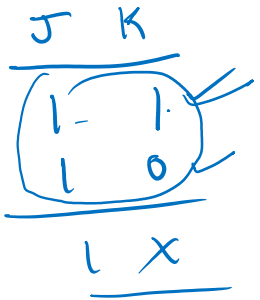


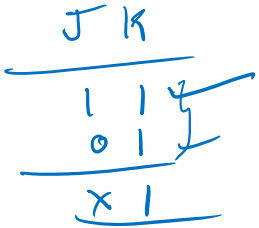
Characteristic Table

CLK	J	K	Q(t+1)	
0	X	X	—	
↑	0	0	Q(t)	No change
↑	0	1	0	clear to 0.
↑	1	0	1	set to 1
↑	1	1	Q'(t)	complement









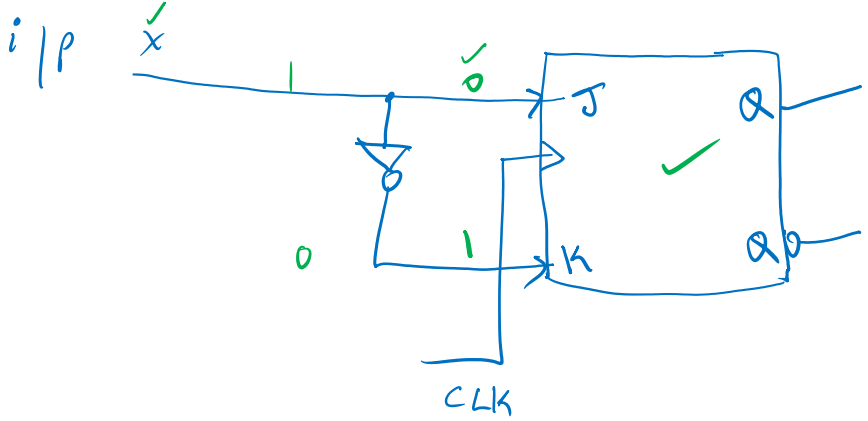
Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

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

Flip flops

→ Consider the following JK- flip flop with an Inverter between J and K inputs.



→ Now the Circuit will function like which flip flop ?

Sol :-

It is Working Like D- flip flop.

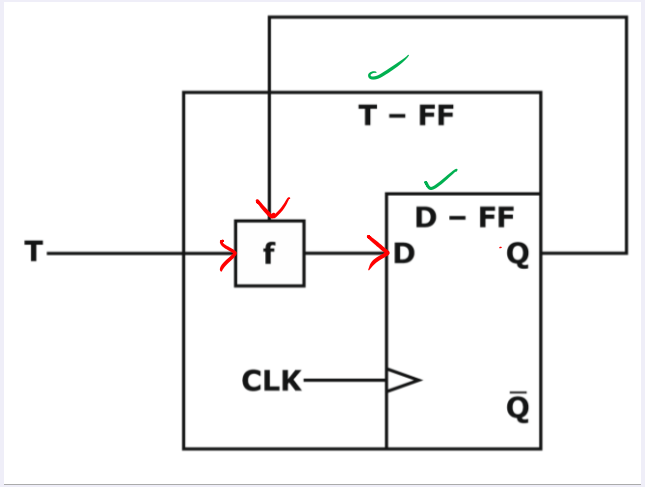
x = 0 ↓ [0|1] clear to 0 ↑

x = 1 ↑ [0|1] set to 1 ↑

Flip flops

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

1.



Q(t)
D
T

D = Q(t+1)

The function f should be

A. $T \oplus Q$

B. $T \odot Q$

C. $T + \overline{Q}$

D. $T\overline{Q}$

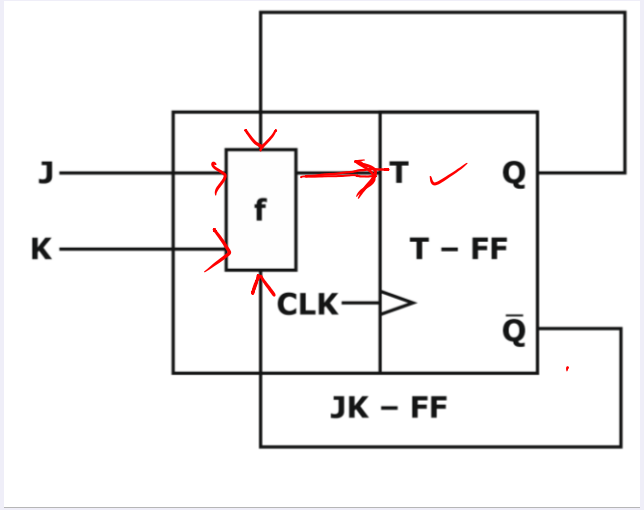
$Q'T + QT'$

$Q \oplus T$

Flip flops

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

2. What should be the function f to make the circuit a JK-FF ?



A. $JQ + K\bar{Q}$

B. $\bar{J}Q + K\bar{Q}$

C. $J\bar{Q} + KQ$

D. None

$T = \bar{J}K + JQ$

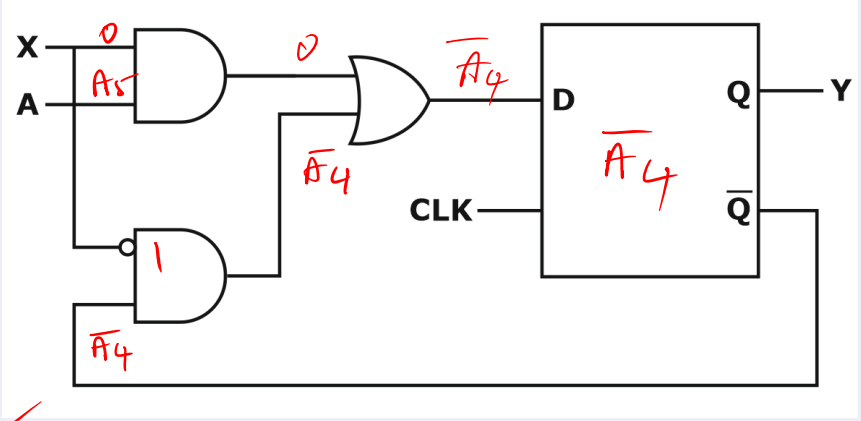
$\bar{Q}J\bar{K} + \bar{Q}JK + Q\bar{J}K + QJK$

$\bar{Q}J[\bar{K} + K] + QK[\bar{J} + J]$

$\bar{Q}J + QK$

Flip flops

3. Consider the following realization with X and A as external control signals. If they are given for 6 clock cycles, what will be the output y ?



A. $\overline{A}_4$

B. A_5

C. A_3

D. $\overline{A}_3$

CLK	1	2	3	4	5	6
X	1	0	0	1	1	0
A	A_0	A_1	A_2	A_3	A_4	A_5

Basics of Flip flops

Q(t)	Q(t+1)	M	N
0	0	1	X
0	1	0	X
1	0	X	0
1	1	X	1

4. Consider the characteristic table below for MN Flip flop

M	N	Q(Next)
0	0	$\bar{Q}$ (complement)
0	1	1 (set to 1)
1	0	0 (clear to 0)
1	1	Q (No change)

M	N
0	1
0	0
0	X

M	N
1	1
1	0
1	X

M	N
0	0
1	0
X	0

M	N
1	1
0	1
X	1

Which of the following denotes the excitation table of the MN flip-flop ?

A.

Q (PS)	Q (NS)	M	N
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

B.

Q (PS)	Q (NS)	M	N
0	0	X	0
0	1	X	1
1	0	1	X
1	1	0	X

C.

Q (PS)	Q (NS)	M	N
0	0	X	1
0	1	0	X
1	0	1	X
1	1	X	0

D.

Q (PS)	Q (NS)	M	N
0	0	1	X
0	1	0	X
1	0	X	0
1	1	X	1