



EC/EE/CS & IT/IN

Digital Electronics

**JK Flip Flop, D &
T Flip Flop ,
Designing of Flip
flop**



LECTURE NO. 8

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कोशिश करने वालों की **हार** नहीं होती

कोशिश करने वालों की हार नहीं होती,
लहरों से डरकर नौका पार नहीं होती।
नन्हीं चीटी जब दाना लेकर चलती है,
चढ़ती दीवारों पर, सौ बार फिसलती है।
मन का विश्वास रगों में साहस भरता है,
चढ़कर गिरना, गिरकर चढ़ना ना अखरता है।
आखिर उसकी मेहनत बेकार नहीं होती,
कोशिश करने वालों की हार नहीं होती।
डुबकियां सिंधु में गोताखोर लगाता है,
जा जाकर खाली हाथ लौट आता है।
मिलते नहीं सहज ही मोती गहरे पानी में,
बढ़ता दुगुना उत्साह इसी हैरानी में।
मुट्ठी उसकी खाली हर बार नहीं होती,
कोशिश करने वालों की हार नहीं होती।
असफलता एक चुनौती है, इसे स्वीकार करें,
क्या कमी रह गयी, देखों और सुधार करें
जब तक न सफल हो, नींद चैन से त्यागो तुम
संघर्ष का मैदान छोड़कर मत भागो तुम।
कुछ किये बिना ही जय जयकार नहीं होती,
कोशिश करने वालों की हार नहीं होती।

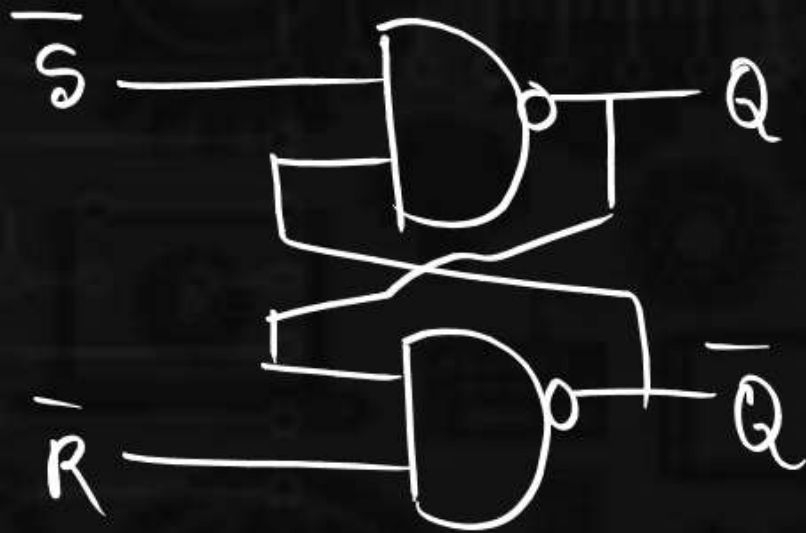


RECAPE

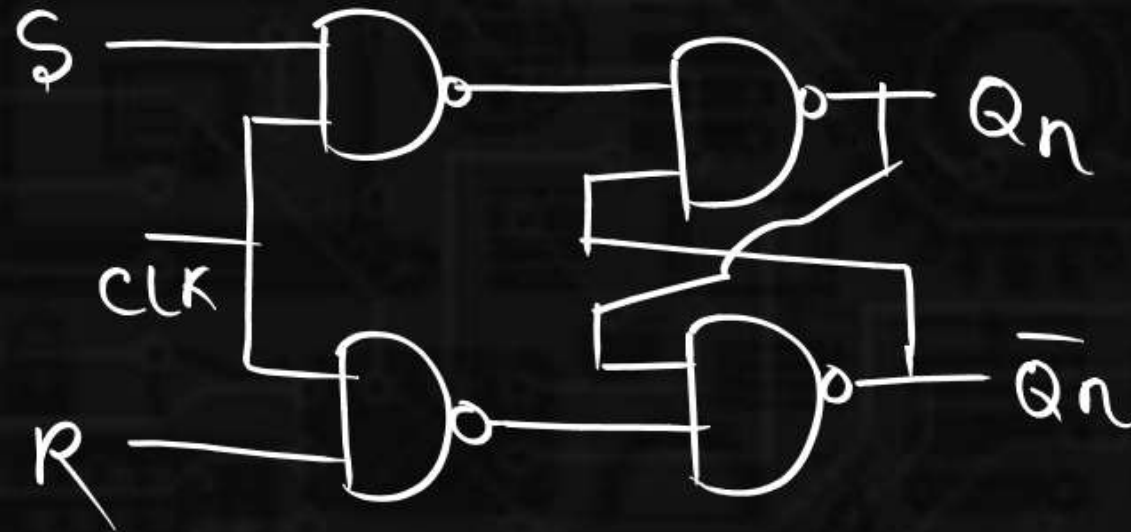


Latches:

SR-Latch



S-R Flip-Flop



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

Characteristic Equation

$$Q_{n+1} = S + \bar{R}Q_n$$

Excitation Table

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



✓ 01 JK Flip Flop

✓ 02 D Flip Flop

✓ 03 T Flip Flop

✓ 04 Desiging of Flip Flops

JK Flip Flop

Jack Keilby.



(1) Symbol



(2) Truth Table

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



JK Flip Flop



(3) Characteristic Table

J	K	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	\bar{Q}_n

0
1
2
3
4
5
6
7

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

JK Flip Flop



(4) Characteristic Equation

$$Q_{n+1}(J, K, Q_n) = \sum m(1, 4, 5, 6)$$

$J \backslash K Q_n$	00	01	11	10
0		1		
1	1	1		1

$$Q_{n+1} = J\bar{Q}_n + KQ_n$$

JK Flip Flop



(5) Excitation Table

Q_n	Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

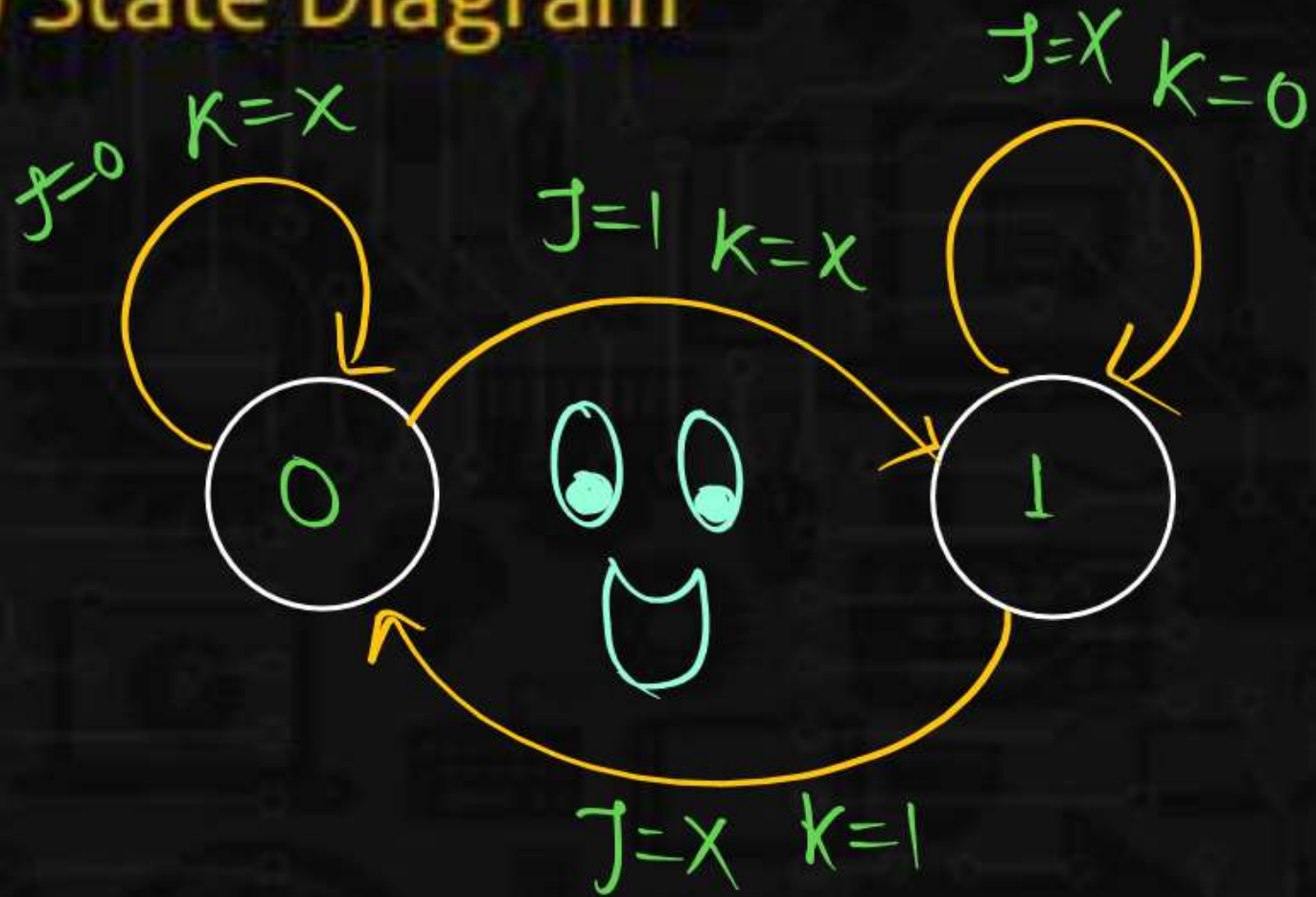
characteristic Table.

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

JK Flip Flop



(6) State Diagram



Q_n	Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Triggering

Level

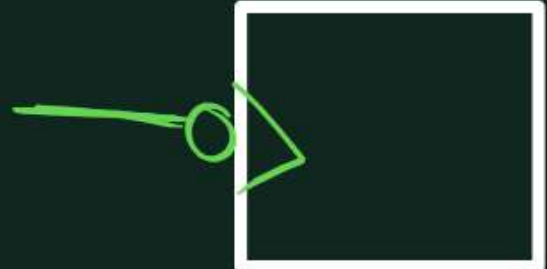
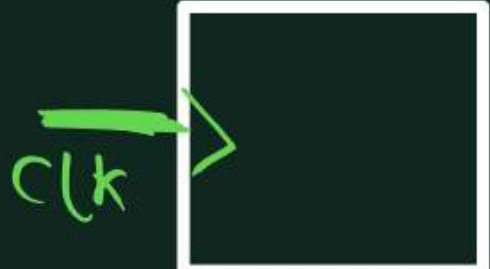
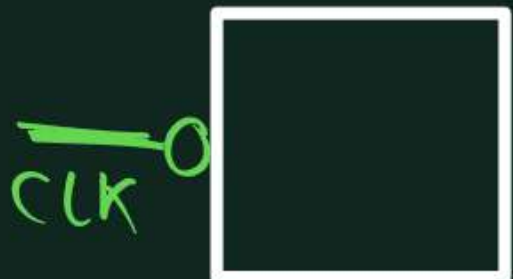
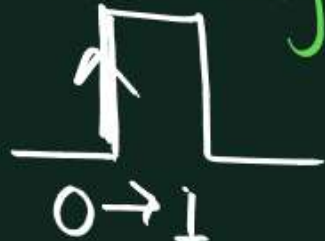
Edge

+ve Level

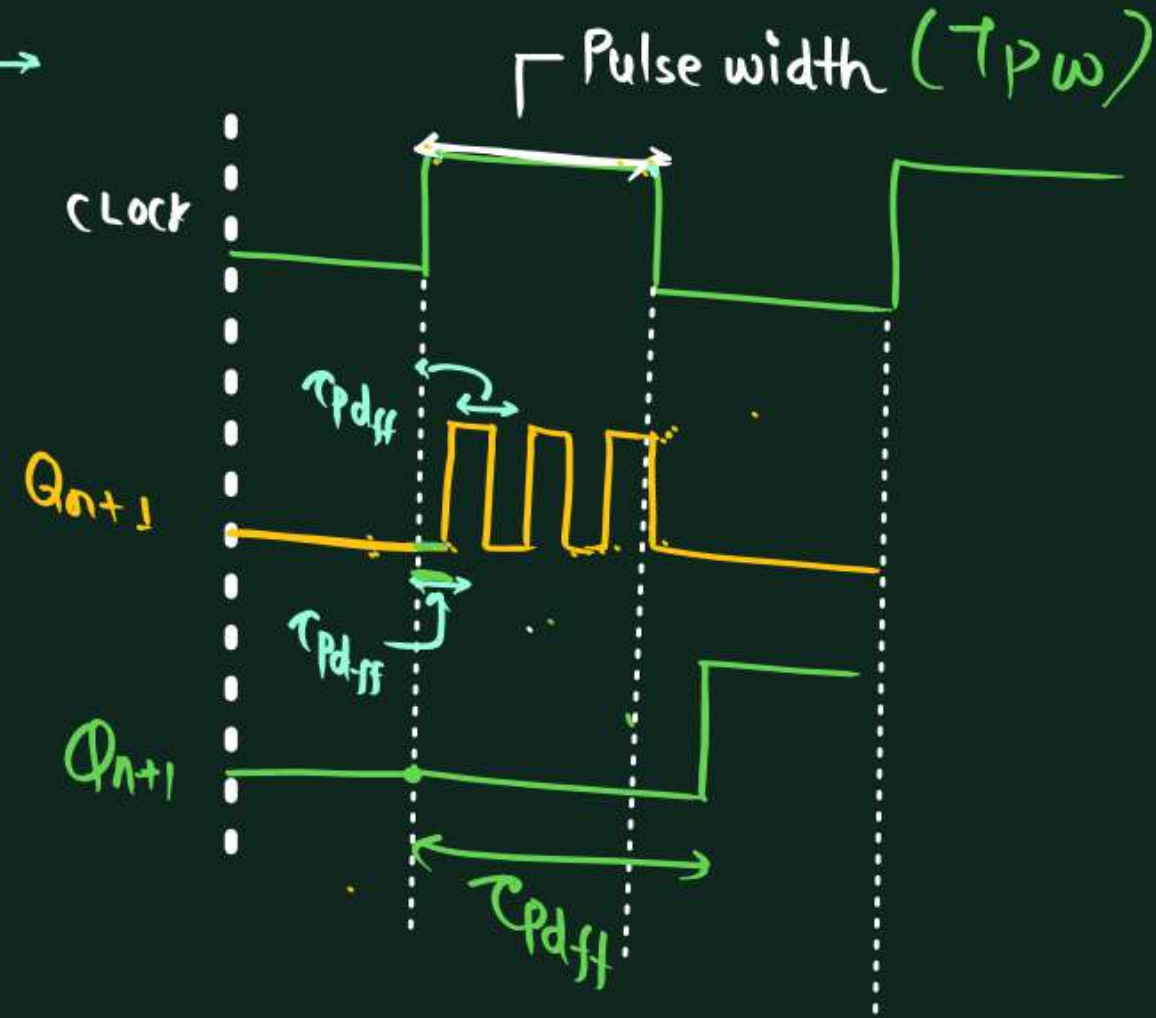
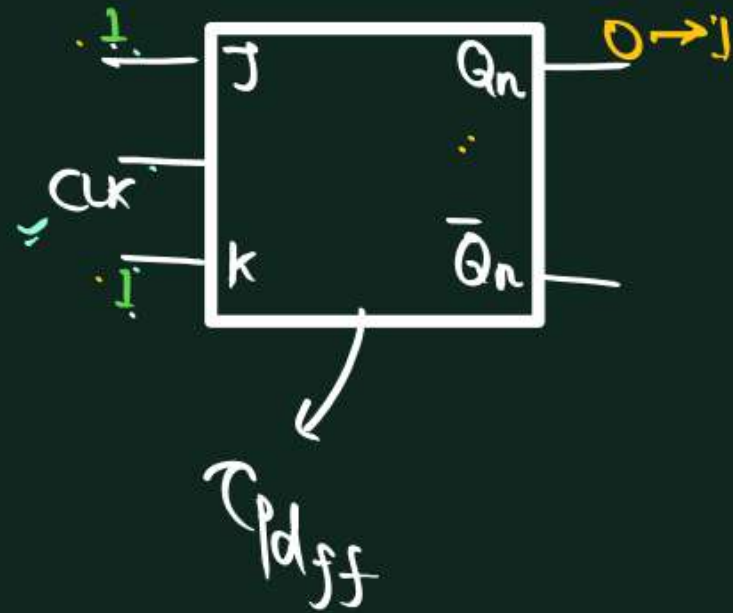
-ve Level

+ve edge

-ve edge

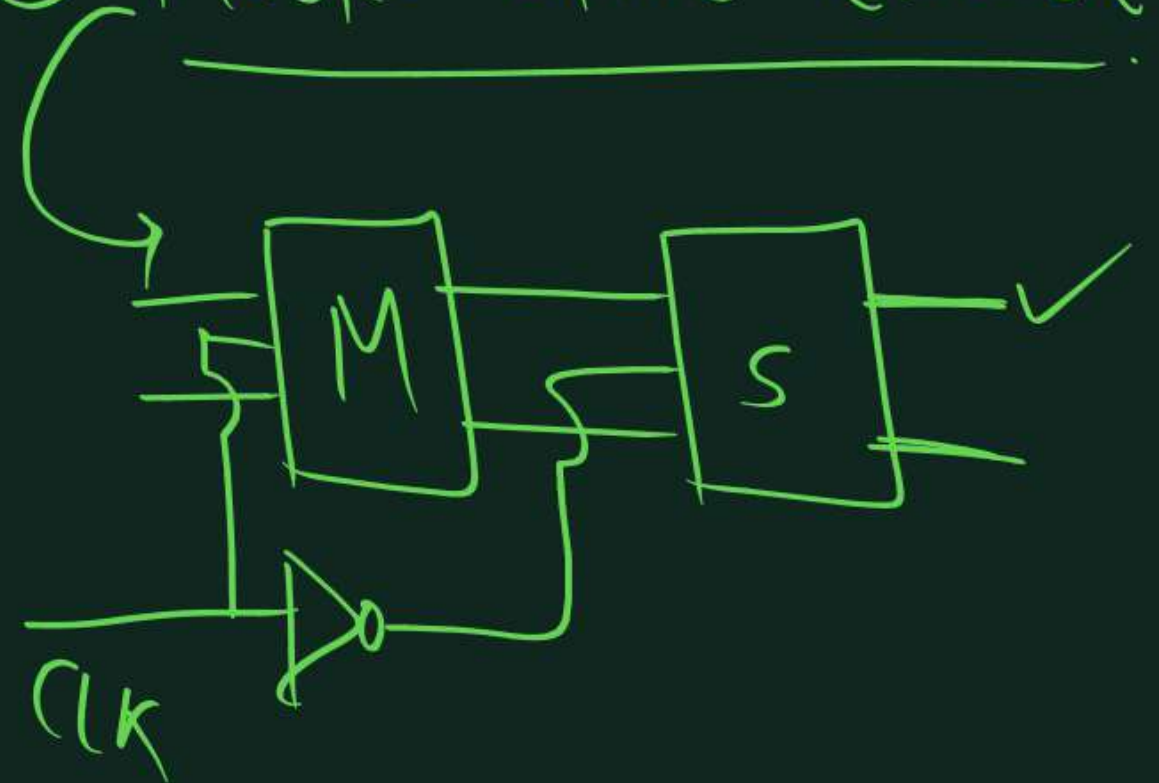


Race around Problem :->



To avoid Race Around problem

- ① $\tau_{pw} < \tau_{pdff} < T_{clk}$
- ② Master-Slave circuit



DJ wale Babu → Ashmit

t=0

t=10min



DJ

S

Sp

Rj

DR

Nishu

Rahul

AR

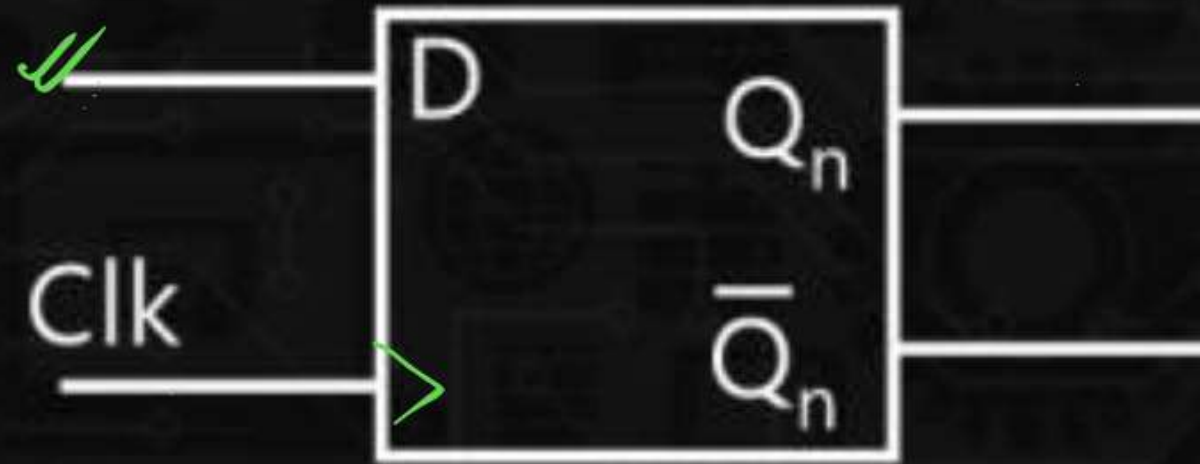
unicorn

D Flip Flop

Data, Transparent

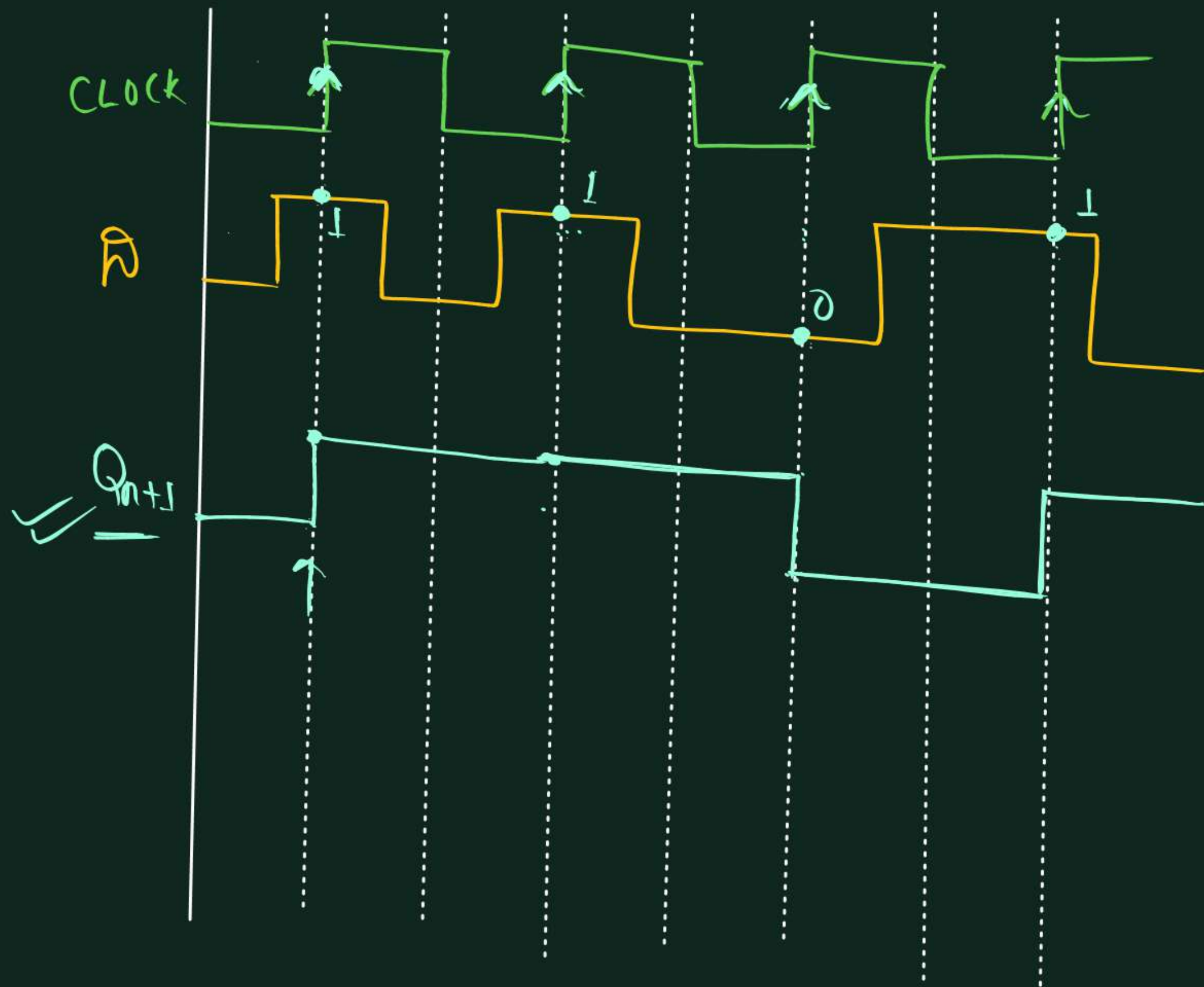
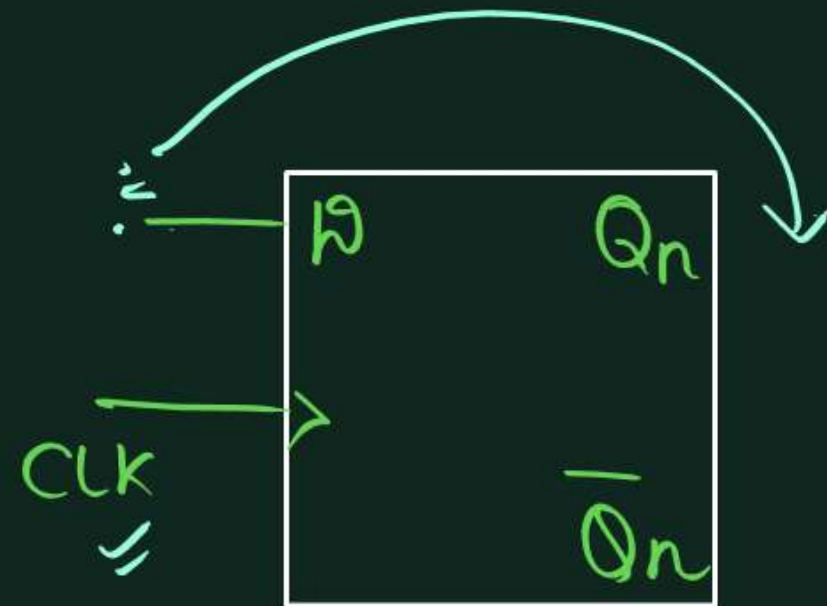


(1) Symbol



(2) Truth Table

D	Q _{n+1}
0	0
1	1



D Flip Flop



(3) Characteristic Table

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

$$\begin{aligned}Q_{n+1} &= D\bar{Q}_n + DQ_n \\ &= D(\bar{Q}_n + Q_n) \\ &= D\end{aligned}$$

D Flip Flop



(4) Characteristic Equation

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

SR

$$Q_{n+1} = S + \bar{R}Q_n$$

JK

$$Q_{n+1} = J\bar{Q}_n + \bar{K}Q_n$$

DFF

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

D Flip Flop

(5) Excitation Table

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

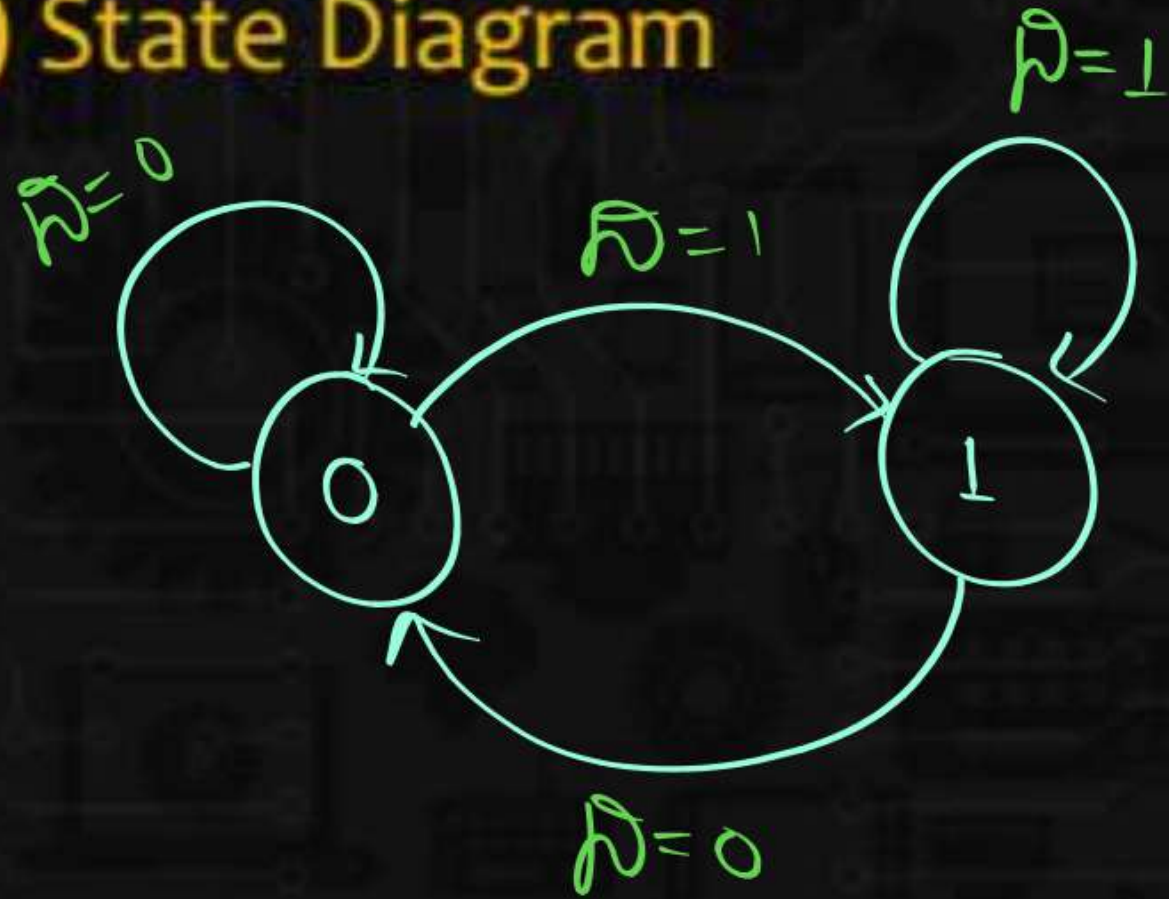
D	Q_n	Q_{n+1}
0 ✓	0	0
0	1	0
1	0	1
1	1	1

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

D Flip Flop



(6) State Diagram



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



इतिहास का महान चित्रकार

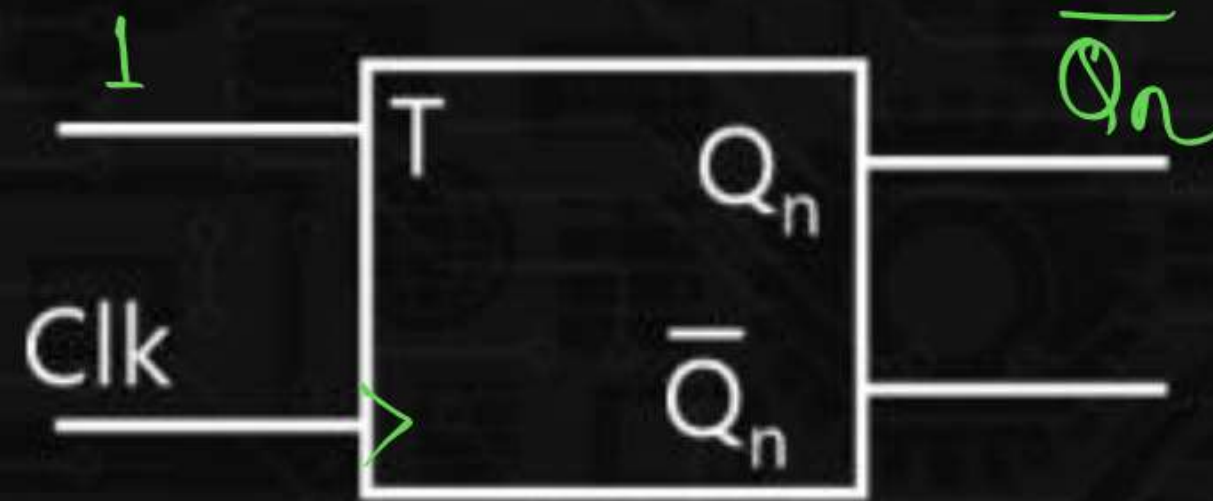
PICASSO



T Flip Flop

Toggle FF

(1) Symbol



(2) Truth Table

T	Q_{n+1}
0	Q_n
1	\bar{Q}_n

T Flip Flop



(3) Characteristic Table

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

$$\begin{aligned} T=0 & \quad Q_{n+1}=Q_n \\ T=1 & \quad Q_{n+1}=\bar{Q}_n \end{aligned}$$

$$Q_{n+1} = \bar{T}Q_n + T\bar{Q}_n$$

$$Q_{n+1} = T \oplus Q_n$$

T Flip Flop



(4) Characteristic Equation

$$Q_{n+1} = T \oplus Q_n$$

T Flip Flop



(5) Excitation Table

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

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

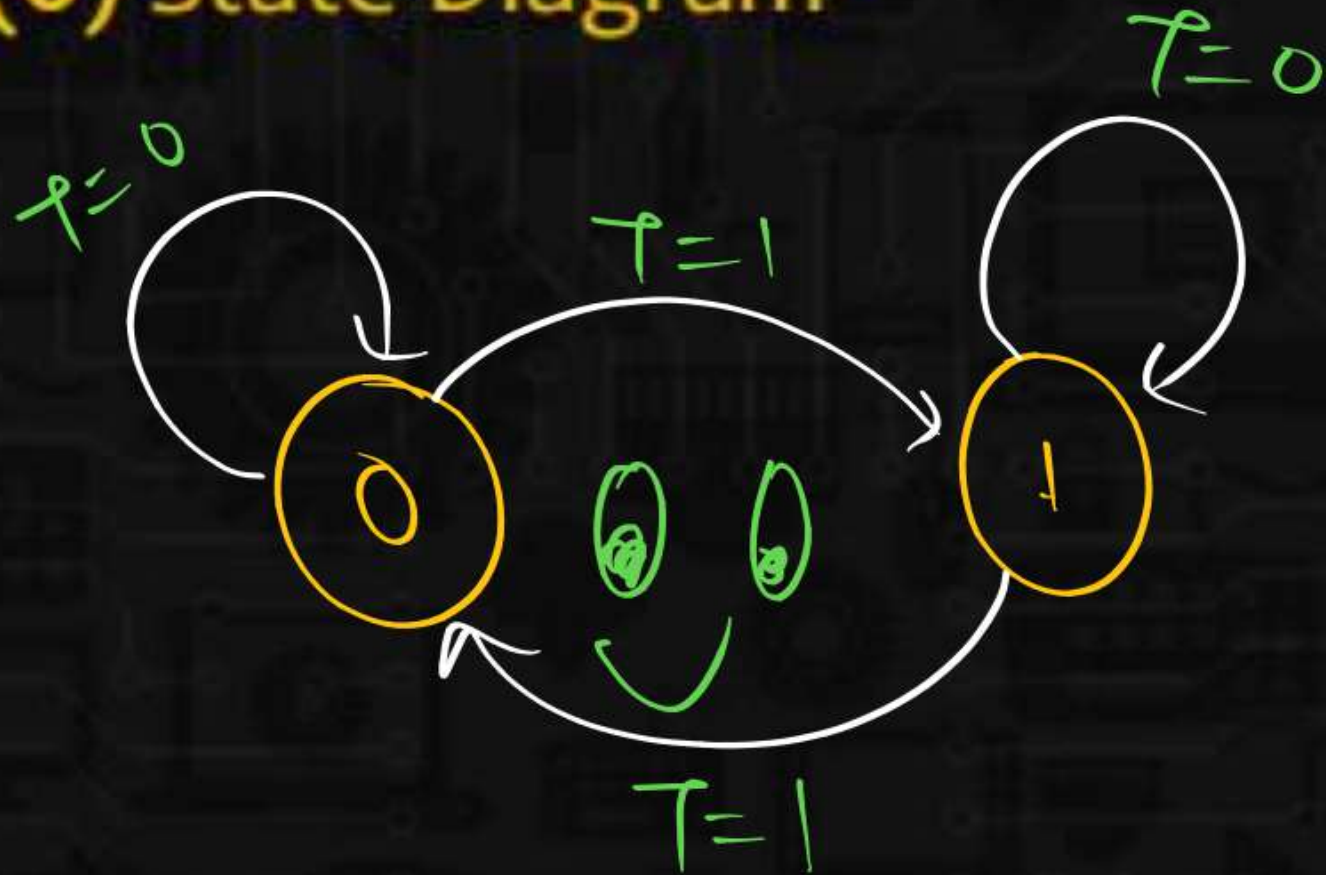
$$Q_{n+1} = T \oplus Q_n$$

$$T = Q_n \oplus Q_{n+1}$$

Φ Flip Flop



(6) State Diagram



Q_n	Q_{n+1}	Φ
0	0	0
0	1	1
1	0	1
1	1	0

Q.1

The J-K FF shown below is initially cleared and then clocked for 5 pulses, the sequence at the Q output will be

A.

010000

B.

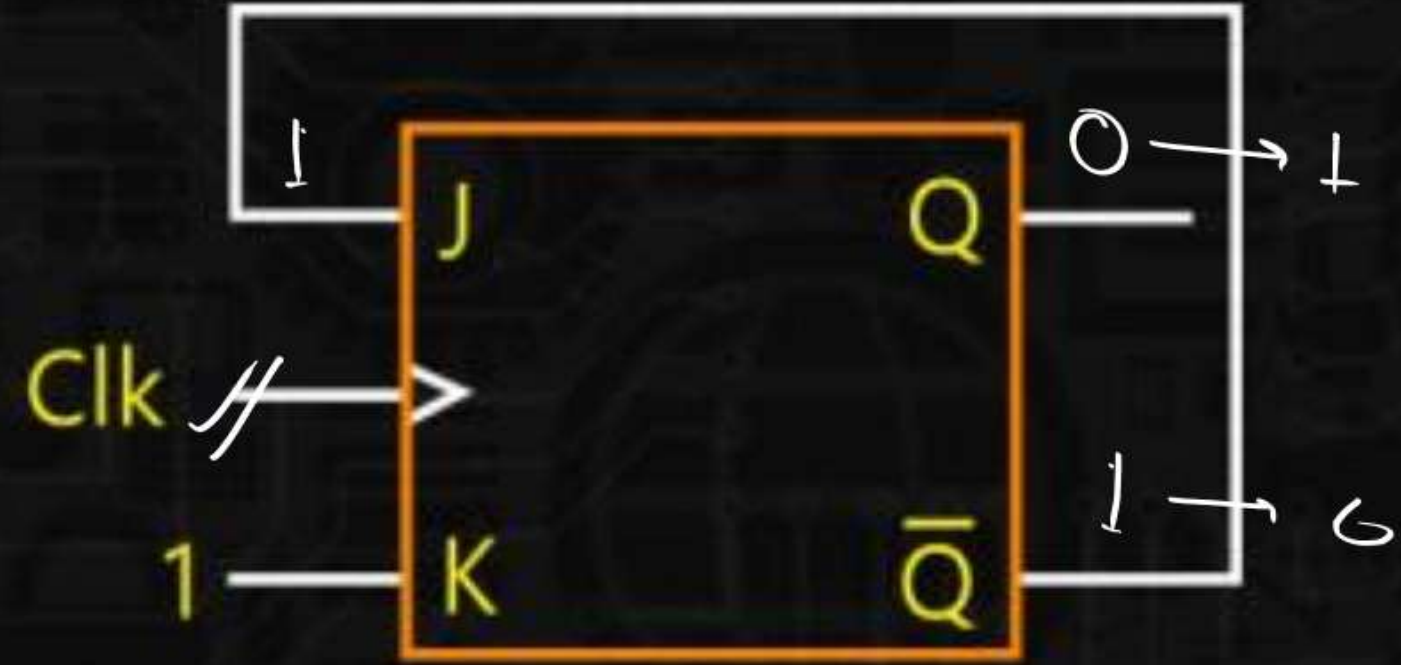
011001

C.

010010

D.

010101



0 → 1 → 0 → 1 → 0 → 1

Q.1

For the circuit given below x & y condition will be–

- A. x stable y toggle
- B. x toggle y stable
- C. x & y both toggle
- D. x & y both stable

Designing of Flip Flops



available FF $\xrightarrow{\quad}$ Desired FF
 E^- C

- ✓ Step (1): Write the characteristic table of desired Flip Flop.
- ✓ Step (2): Write the excitation table of available Flip Flop.
- { Step (3): Write the logical expression.
- Step (4): Minimize the logical expression.
- Step (5): Hardware implementation.

CD
 \rightarrow chara. table
desired

Q.2

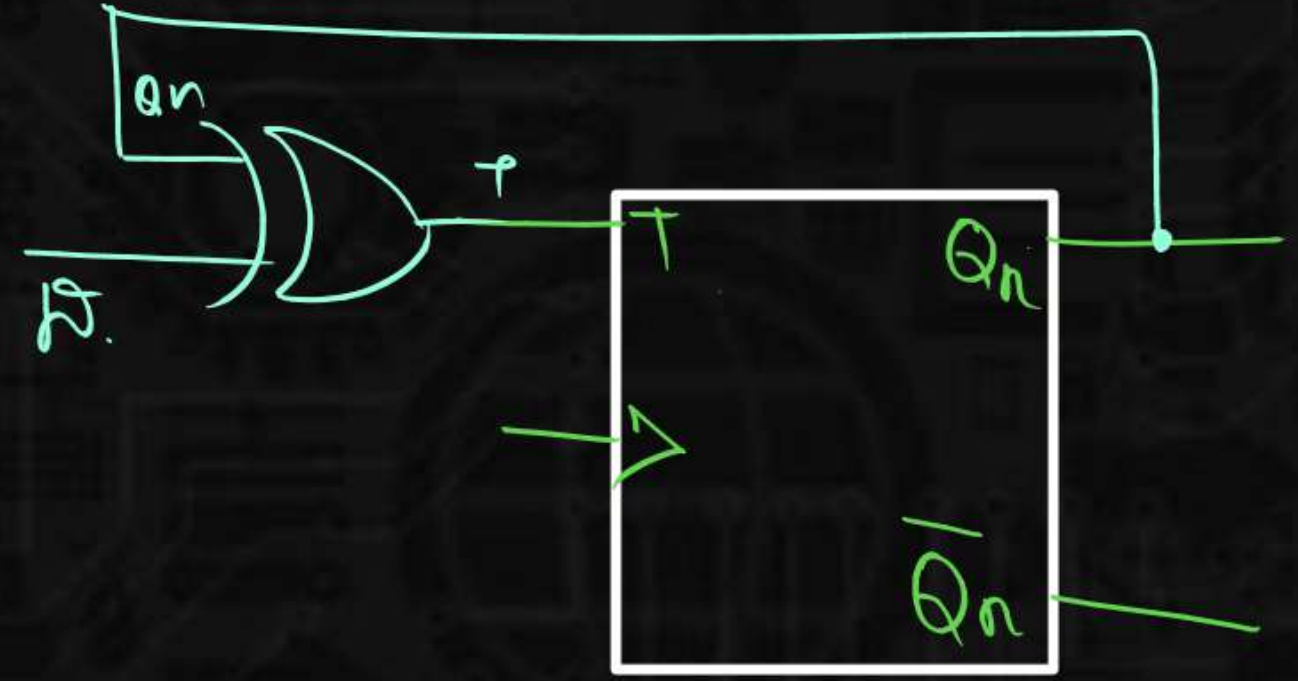
Design a ^{Desired} D FF by using T FF?

Excitation Table:

Step 1
Step 2

D	Q _n	Q _{n+1}	T
0	0	0	0
0	1	0	1
1	0	1	1
1	1	1	0

Step 5



Step 3. $T = \bar{D}Q_n + D\bar{Q}_n$
 $(T = D \oplus Q_n)$
 Step 4:

Q.3

Design a ^{Desired} D FF by using ^{available} SR Flip Flop?

Step-1
& Step-2.

D	Q _n	Q _{n+1}	S	R
0	0	0	0	X
0	1	0	0	1
1	0	1	1	0
1	1	1	X	0

Step 3. $S(Q_n, Q_{n+1}) = \sum m(2) + \sum d(3)$

Step 4.

$S \Rightarrow$

D \ Q _n	0	1
0		
1	1	X

$S = Q_n$

$R(Q_n, Q_{n+1}) = \sum m(1) + \sum d(0)$

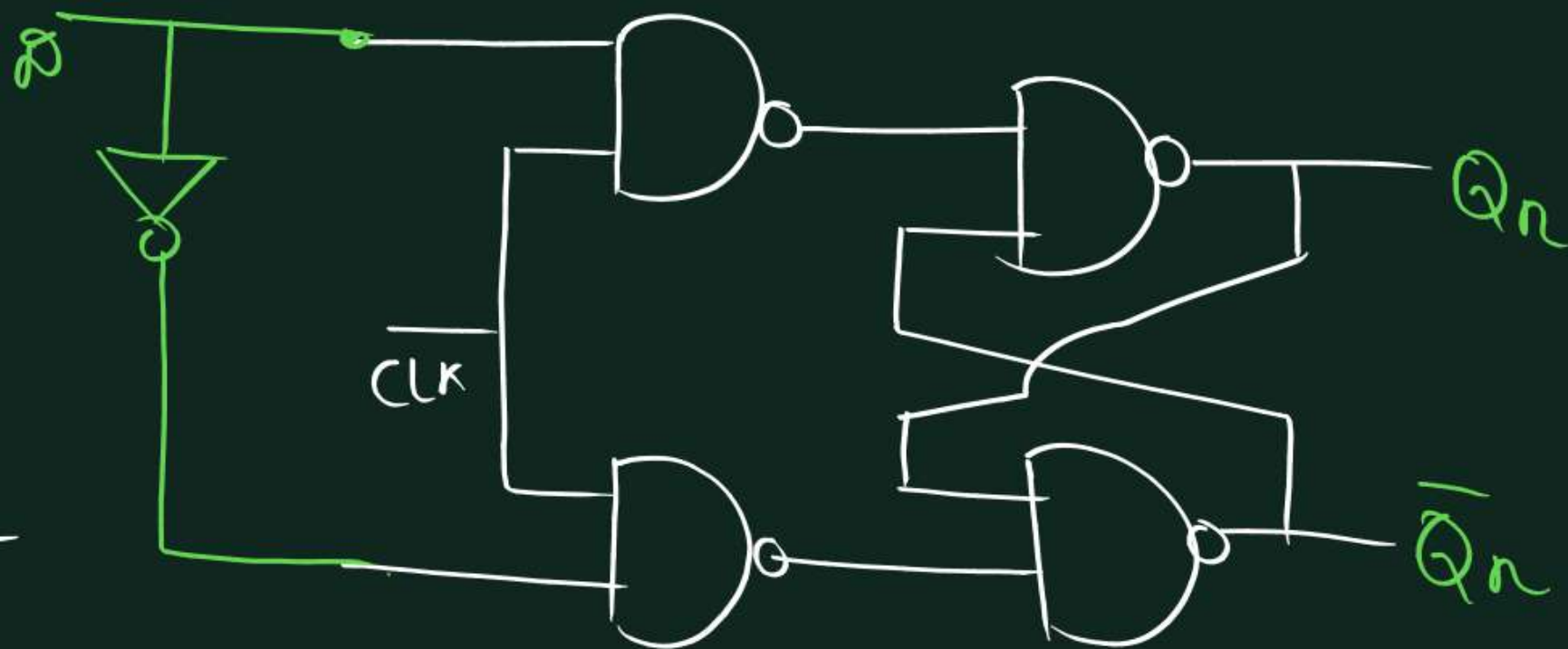
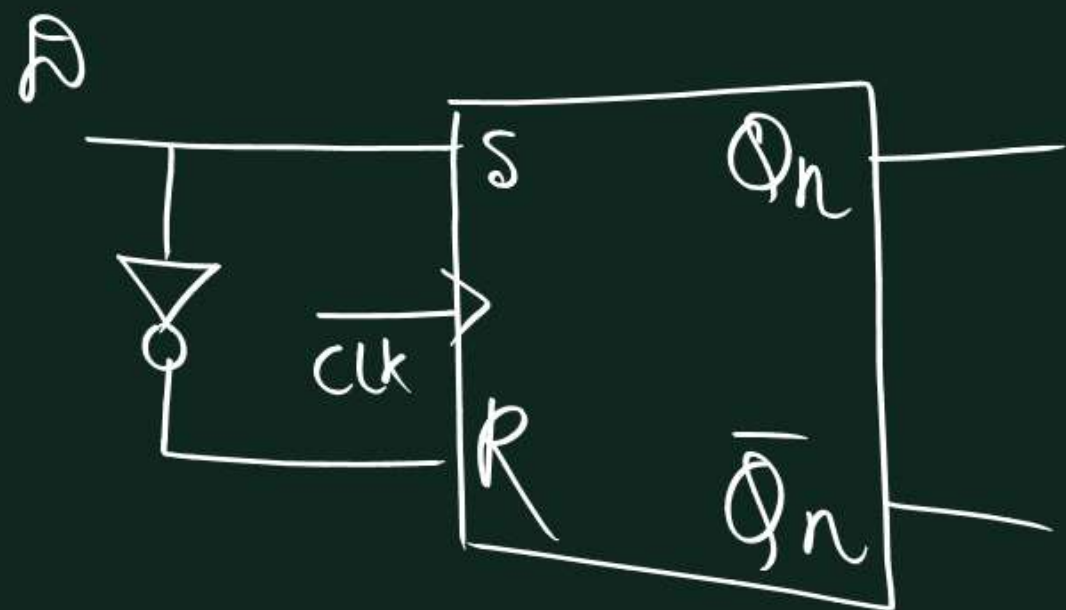
D \ Q _n	0	1
0	X	1
1		

$R = \bar{D}$

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$$S = D$$

$$R = \overline{D}$$



Q.4

Design a D FF by using JK FF?

How

$$f(D, Q_n)$$

$$x(D, Q_n)$$

D	Q _n	Q _{n+1}	J	K
0	0	0		
0	1	0		
1	0	1		
1	1	1		

Q.5

Design a JK FF by using SR FF?



Q.6

Design a JK FF by using SR FF?

Q.7

Design a CJ by using SR FF?



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

(f → chandan jha)

Comment

$$S = (C, J, Q_n)$$

$$R = (C, J, Q_n)$$

$$S = ?$$

$$R = ?$$

Step (1)



C	J	Q_n	Q_{n+1}	S	R
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

C	J	Q_{n+1}
0	0	1
0	1	0
1	0	Q_n
1	1	Q_n

Flip Flops

Discussion



