Flip-Flop

Jk Flip-Flop

Jack keilby → Papa of IC

IC Integrated circuit

INTEL

Nobel prize

Gorden E. Moore

1962 Team दुकान

1965

Statement

Moore's Law

1element ← 1958

2element ← 1960

4 element ← 1962

8element ← 1964

→ Latches with control phenomenon are called Flip-Flop.

SR Flip-Flop

S

Clock

R

31st oct

Clock

① ② ③ ④ n^{th} $(n+1)^{th}$

Q_1 Q_2 Q_3 Q_4 Q_n Q_{n+1}
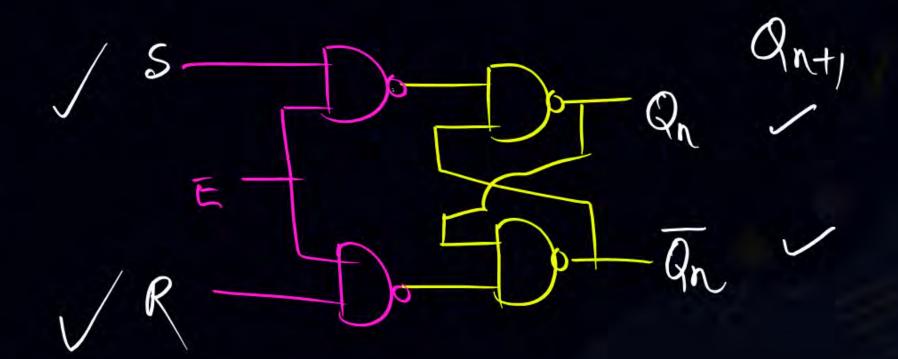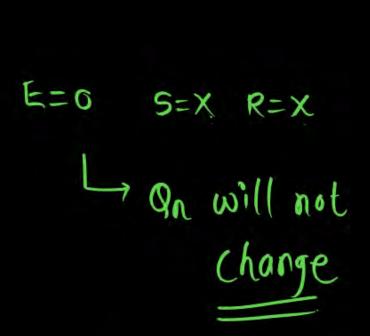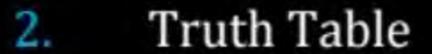
① Circuit Diagram [Symbol]

② Truth table.

③ Characteristic Table.

④ Characteristic Equation

⑤ Excitation Table.

⑥ State Diagram

1. Circuit Diagram

$$E=0 \quad S=X \quad R=X$$

$\hookrightarrow Q_n$ will not <u>change</u>

Q_{n+1}

S — [NAND]

Enable

R — [NAND]

$\overline{Q}_n$

Q_n

$1 \cdot \overline{Q}_n$ [NAND] → $Q_n = Q_n$

$Q_n \cdot 1$ [NAND] → $\overline{Q}_n = \overline{Q}_n$

SR Latch

2. Truth Table

J   K

S	R	Q_{n+1}	$\overline{Q}_{n+1}$	
0	0	Q_n	$\overline{Q}_n$	HOLD / MEMORY / PREVIOUS STATE
0	1	0	1	RESET
1	0	1	0	SET
1	1	X	X	INVALID / FORBIDDEN / don't care

③
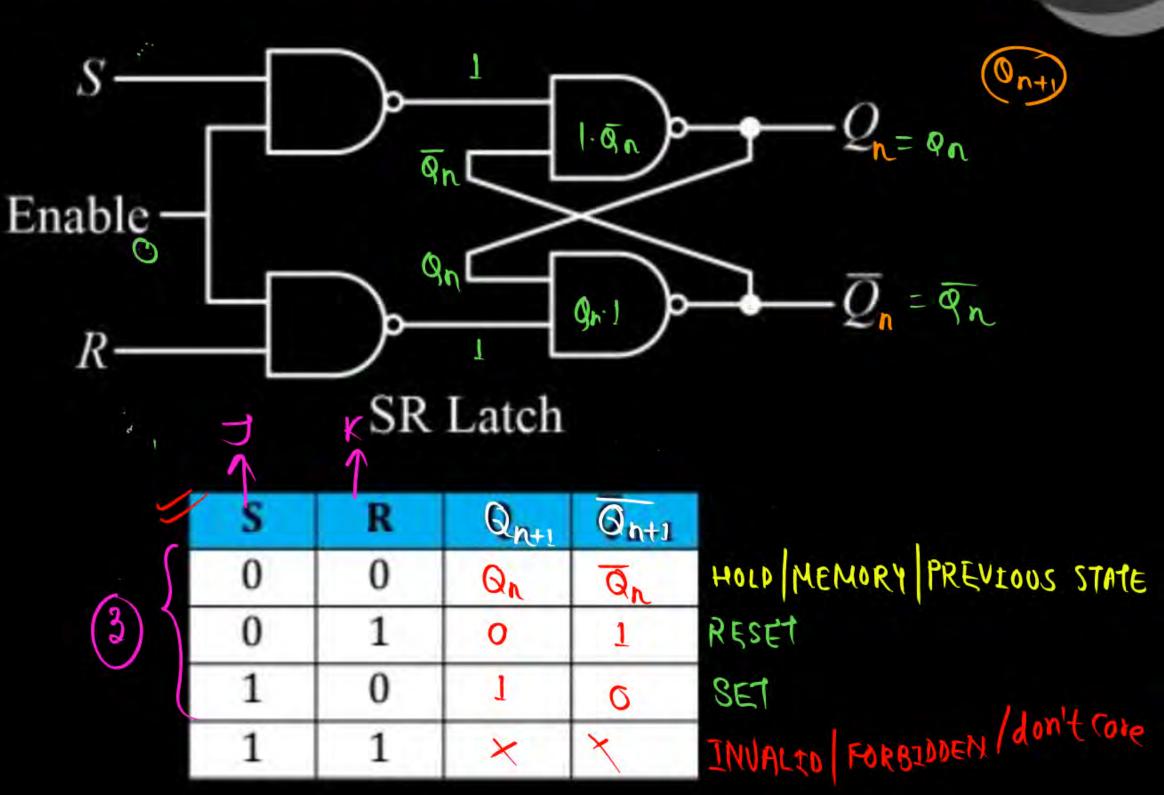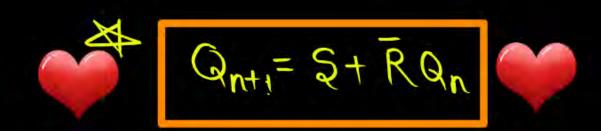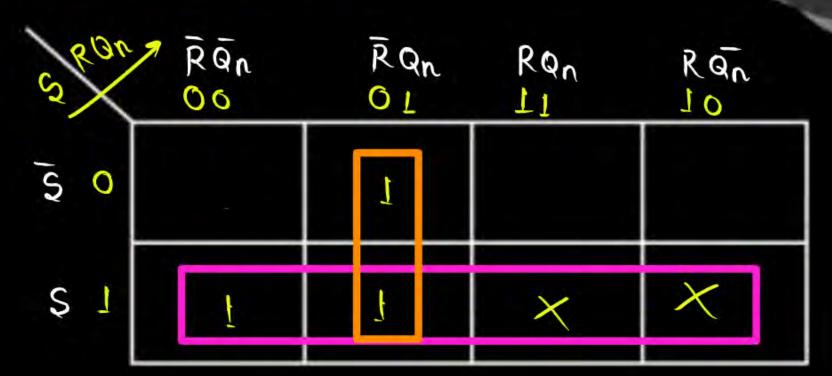
3. Characteristics Table

	S	R	Q_n	Q_{n+1}
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	X
7	1	1	1	X

$$Q_{n+1}(S, R, Q_n) = \Sigma m(1, 4, 5) + \Sigma d(6, 7)$$

4. Characteristics Equation

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

S \ RQ_n	$\bar{R}\bar{Q}_n$ 00	$\bar{R}Q_n$ 01	RQ_n 11	$R\bar{Q}_n$ 10
$\bar{S}$ 0		1		
S 1	1	1	$\times$	$\times$
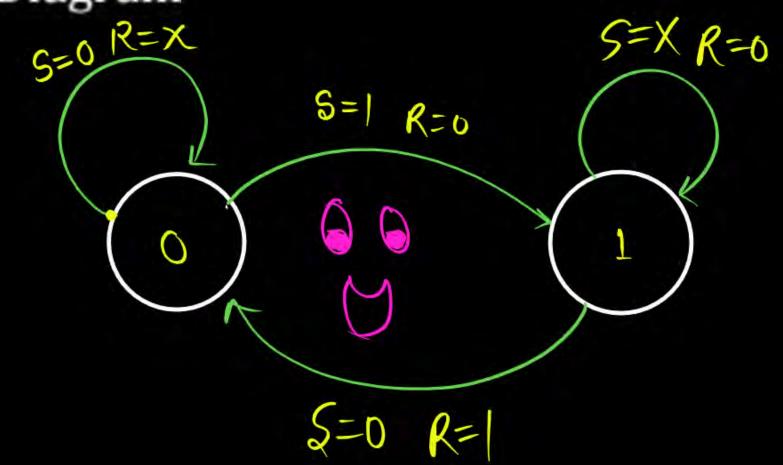
5. Excitation Table

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

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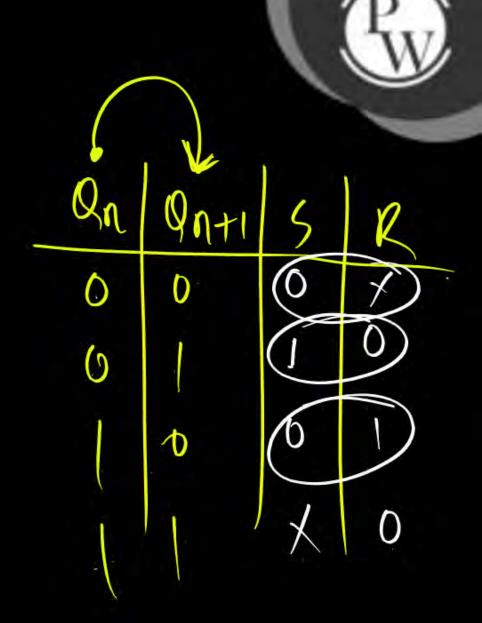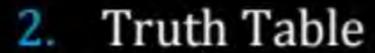
S	R	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	X
1	1	1	X

6. State Diagram

$$S=0 \quad R=X$$

$$S=1 \quad R=0$$

$$S=X \quad R=0$$

$$S=0 \quad R=1$$

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

JK FLIP FLOP

1. Symbol

J ——
CLK —>
K ——
J-K flip flop
—— Q_n
—— $\overline{Q}_n$

2. Truth Table
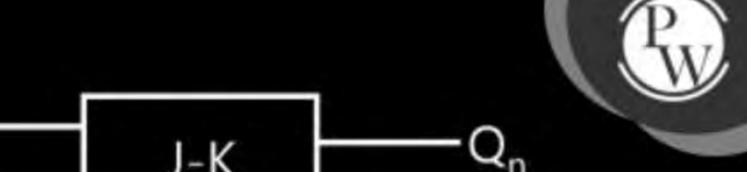
J	K	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q}_n$

JK FLIP FLOP

3. Characteristics Table
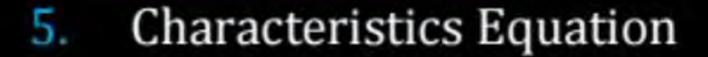
J	K	Q_n	Q_{n+1}
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

4. Characteristics Equation

5. Characteristics Equation

Q_n	Q_{n+1}	J	K