

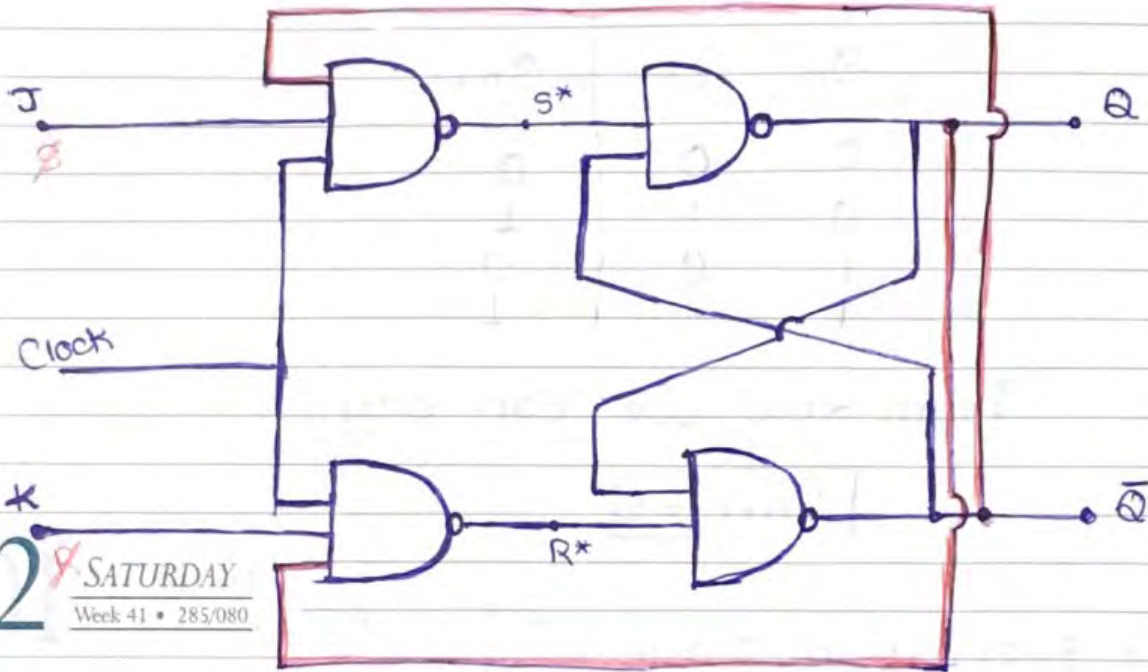
OCTOBER 2013

| OCTOBER |    |    |    |    |    |    | 2013 |
|---------|----|----|----|----|----|----|------|
| S       | M  | T  | W  | T  | F  | S  |      |
|         |    | 1  | 2  | 3  | 4  | 5  |      |
| 6       | 7  | 8  | 9  | 10 | 11 | 12 |      |
| 13      | 14 | 15 | 16 | 17 | 18 | 19 |      |
| 20      | 21 | 22 | 23 | 24 | 25 | 26 |      |
| 27      | 28 | 29 | 30 | 31 |    |    |      |

11 FRIDAY  
Week 41 • 284/081

# J K Flip Flop

• Ckt of JK Flip Flop :-



12 SATURDAY  
Week 41 • 285/080

• Working of JK Flip Flop -

Case 1) →

When CLK = 0

So, at S\* and R\* = 1 and from SR Latch TT whenever S/R is 1,1 the O/P is stored i.e. Memory state

O/P is Memory

toggle

# Truth Table of JK Flip Flop :-

| CLK | J | K | $Q_{n+1}$            |
|-----|---|---|----------------------|
| 0   | x | x | $Q_n$ (Memory)       |
| 1   | 0 | 0 | $Q_n$ (Memory)       |
| 1   | 0 | 1 | 0                    |
| 1   | 1 | 0 | 1                    |
| 1   | 1 | 1 | $\bar{Q}_n$ (Toggle) |

17 Case 2)  
 THURSDAY  
 Week 42 • 290/075

when CLK = 1  
 $J = 1, K = 0$   
 $\downarrow$   
 $Q = 1, \bar{Q} = 0$

Case 3) when CLK = 1  
 $J = 0, K = 1$   
 $\downarrow$  (From SR Truth Table)  
 $Q = 0, \bar{Q} = 1$

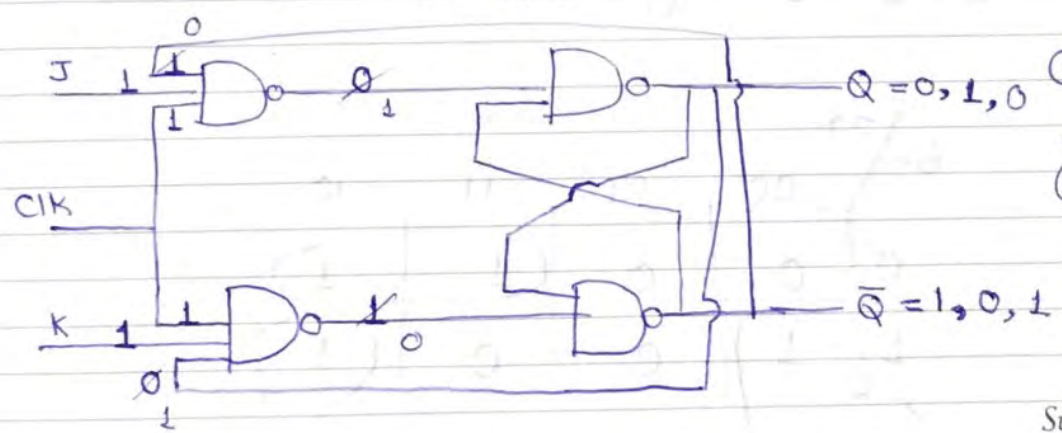
Case 4) CLK = 1  
 $J = 1 \rightarrow Q = 0, 1, 0, 1, \dots$   
 $K = 1 \rightarrow \bar{Q} = 1, 0, 1, 0, \dots$

T.T for SR Flip Flop:-

| CLK | S | R | Q <sub>n+1</sub>        |
|-----|---|---|-------------------------|
| 0   | X | X | Q <sub>n</sub> (Memory) |
| 1   | 0 | 0 | Q <sub>n</sub> (Memory) |
| 1   | 0 | 1 | 0                       |
| 1   | 1 | 0 | 1                       |
| 1   | 1 | 1 | Not used                |

Let's analyse this last case for that assume

Q = 0 & Q̄ = 1



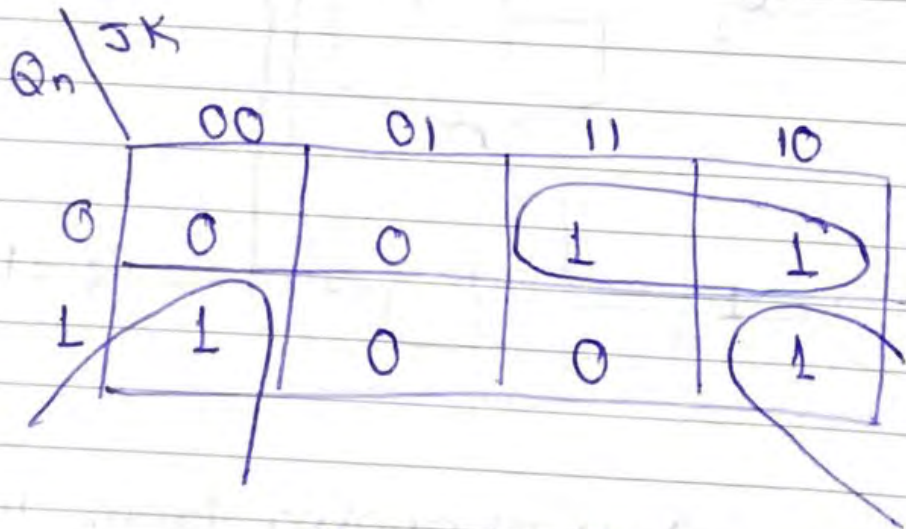
- ① from SR latch, o/p 1, 0
- ② o/p 0, 1

We can see Q is changing from 1, 0, 1 and so on and this is known as racing

# Characteristic Table of JK Flip Flop :-

| $Q_n$ | J | K | $Q_{n+1}$ |
|-------|---|---|-----------|
| 0     | 0 | 0 | 0         |
| 0     | 0 | 1 | 0         |
| 0     | 1 | 0 | 1         |
| 0     | 1 | 1 | 1         |
| 1     | 0 | 0 | 1         |
| 1     | 0 | 1 | 0         |
| 1     | 1 | 0 | 0         |
| 1     | 1 | 1 | 0         |

**TUESDAY**  
 Week 43 • 295/070



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

# Excitation Table :-

|    | $Q_n$ | $Q_{n+1}$ | J | K |
|----|-------|-----------|---|---|
| 10 | 0     | 0         | 0 | x |
| 12 | 0     | 1         | 1 | x |
| 2  | 1     | 0         | x | 1 |
| 4  | 1     | 1         | x | 0 |

For J

|       |   | $Q_{n+1}$ | 0 | 1 |
|-------|---|-----------|---|---|
| $Q_n$ | 0 | 0         | 0 | 1 |
| 1     | x | x         | x | x |

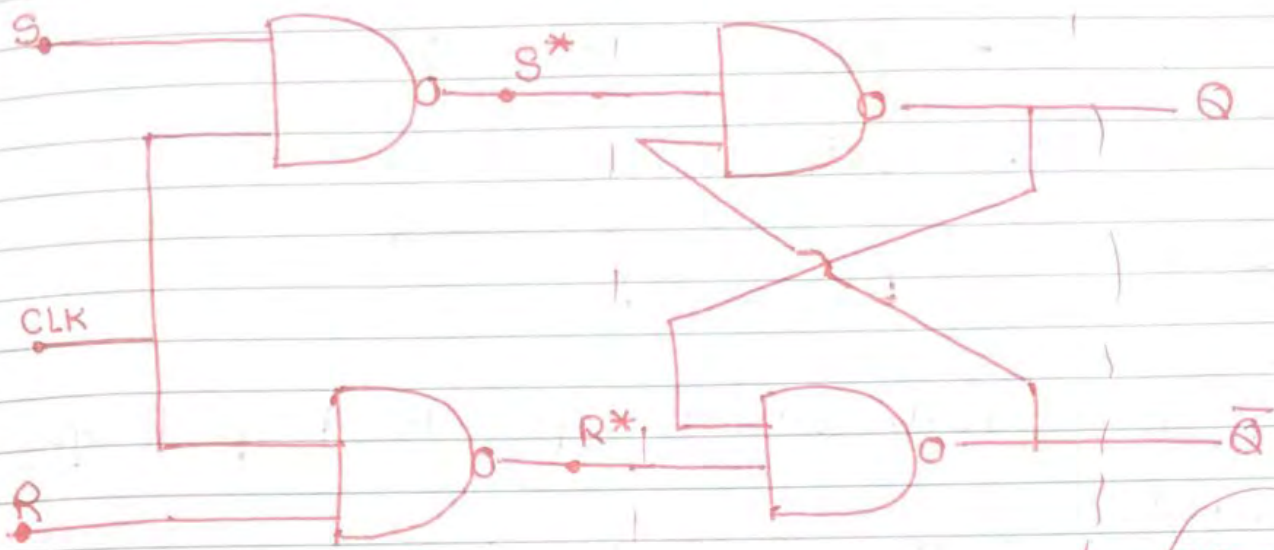
$J = Q_{n+1}$

For K

|       |   | $Q_{n+1}$ | 0 | 1 |
|-------|---|-----------|---|---|
| $Q_n$ | 0 | x         | x | x |
| 1     | 1 | 1         | 0 | 0 |

$K = \overline{Q_{n+1}}$

# Introduction to SR Flip Flop



SR latch with NAND Gate

•  $S^* = \overline{(S \cdot CLK)}$

$= \overline{S} + \overline{CLK}$

•  $R^* = \overline{(R \cdot CLK)}$

$= \overline{R} + \overline{CLK}$  { from DeMorgan's Law

• whole above ckt is SR Flip Flop & CLK is edge triggered

Truth Table of SR latch with NAND Gate

| S* | R* | Q        | Q̄ |
|----|----|----------|----|
| 0  | 0  | Not used |    |
| 0  | 1  | 1        | 0  |
| 1  | 0  | 0        | 1  |
| 1  | 1  | Memory   |    |

$$S^* = (S \cdot CLK) = \bar{S} + CLK$$

$$R^* = (\bar{R} \cdot CLK) = R + \bar{CLK}$$

SEPTEMBER 2013

11

WEDNESDAY

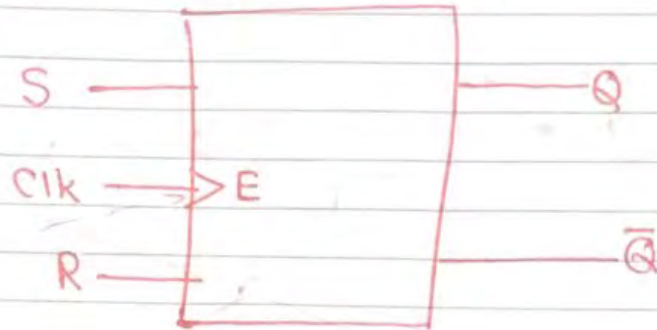
Week 37 • 254/111

| $S^*$ | $R^*$ | Q        | $\bar{Q}$ |
|-------|-------|----------|-----------|
| 0     | 0     | Not Used |           |
| 0     | 1     | 1        | 0         |
| 1     | 0     | 0        | 1         |
| 1     | 1     | Memory   |           |

SEPTEMBER 2013

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  |
| 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 |    |    |    |    |    |

## Symbol of SR Flip Flop



edge triggered  
if not >  
symbol  
then level  
triggered

## Truth Table of SR Flip Flop

| CLK | S | R | Q        | $\bar{Q}$ | Comments |
|-----|---|---|----------|-----------|----------|
| 0   | x | x | Memory   |           |          |
| 1   | 0 | 0 | Memory   |           |          |
| 1   | 0 | 1 | 0        | 1         |          |
| 1   | 1 | 0 | 1        | 0         |          |
| 1   | 1 | 1 | Not used |           |          |

12

THURSDAY

Week 37 • 255/110

8

10

12

2

4

6

8

① when CLK is '0'

$$S^* = 1, R^* = 1$$

② when CLK is '1', S=0, R=0

$$S^* = \bar{S}$$

$$R^* = \bar{R}$$

∴ compliment of '1' is 0

$$\therefore CLK = 0$$

③ when CLK is

16

MONDAY

Week 38 • 259/106

|    |    |    |    |
|----|----|----|----|
| 15 | 16 | 17 | 18 |
| 22 | 23 | 24 | 25 |
| 29 | 30 |    |    |

$$8 \text{ (3) } C|K = 1, S = 0 \text{ and } R = 1$$

10

$$S^* = 1$$

$$R^* = 0$$

12

$$2 \text{ (4) } C|K = 1, S = \frac{1}{\emptyset} \text{ and } R = 0$$

4

$$\therefore S^* = 0$$

$$[\because S^* = \overline{S}]$$

$$R^* = 1$$

6

8

$$\text{(5) } C|K = 1, S = 1 \text{ and } R = 1$$

17

TUESDAY

Week 38 • 260/105

$$\therefore S^* = 0$$

$$R^* = 0$$

8

10

12

2



8 > Characteristic Table and Excitation Table for SR Flip Flop:-

10

12 Truth Table :- Next state

| $\overline{Ck}$ | S | R | $Q_{n+1}$ ←           |
|-----------------|---|---|-----------------------|
| 0               | * | X | $Q_n$ ← Present state |
| 1               | 0 | 0 | $Q_n$ [Memory]        |
| 1               | 0 | 1 | 0                     |
| 1               | 1 | 0 | 1                     |
| 1               | 1 | 1 | Invalid               |

3

Characteristics Table:-

21 SATURDAY Week 38 • 264/101

| $Q_n$ | S | R | $Q_{n+1}$ |
|-------|---|---|-----------|
| 0     | 0 | 0 | 0         |
| 0     | 0 | 1 | 0         |
| 0     | 1 | 0 | 1         |
| 0     | 1 | 1 | X         |
| 1     | 0 | 0 | 1         |
| 1     | 0 | 1 | 0         |
| 1     | 1 | 0 | 1         |
| 1     | 1 | 1 | X         |

*Qn is high* (written vertically on the left side of the table)

22 Sunday

→ 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 |

This excitation table is frequently used in Flip-flop conventions and also in the counters.

NOTES

| $Q_n \backslash SR$ | 00 | 01 | 11 | 10 |
|---------------------|----|----|----|----|
| 0                   | 0  | 0  | X  | 1  |
| 1                   | 1  | 0  | X  | 1  |

(The table above is a Karnaugh map for the excitation table. The cells containing '1' are circled and labeled as 'I' and 'II'. An arrow labeled 'I' points to the '1' in the cell (0, 10), and an arrow labeled 'II' points to the '1' in the cell (1, 10).)

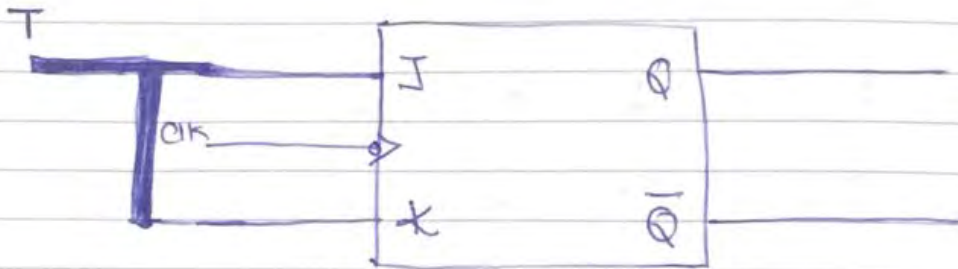
$$Q_{n+1} = I + II$$

$$= S + Q_n \overline{R}$$

T FLIP FLOP

toggle

• Symbol of JK Flip flop conversion to T :-



• Truth Table of T Flip Flop :-

| Clk | T | $Q_{n+1}$                 |
|-----|---|---------------------------|
| 0   | x | $Q_n$ {Memory}            |
| 1   | 0 | $Q_n$ {Memory}            |
| 1   | 1 | $\overline{Q_n}$ {toggle} |

Case 1)  $J=0, K=0$   
 from T.T of JK  
 O/P is Memory

Case 2)  $J=1, K=1$   
 from T.T of JK  
 O/P is  $\overline{Q}$  i.e. toggle

OCTOBER 2013

30 WEDNESDAY  
Week 44 • 303/062

|              |    |    |    |    |    |    |
|--------------|----|----|----|----|----|----|
| OCTOBER 2013 |    |    |    |    |    |    |
| S            | M  | T  | W  | T  | F  | S  |
|              |    | 1  | 2  | 3  | 4  | 5  |
| 6            | 7  | 8  | 9  | 10 | 11 | 12 |
| 13           | 14 | 15 | 16 | 17 | 18 | 19 |
| 20           | 21 | 22 | 23 | 24 | 25 | 26 |
| 27           | 28 | 29 | 30 | 31 |    |    |

Characteristic Table of T Flip Flop :-

| $Q_n$ | T | $Q_{n+1}$ |
|-------|---|-----------|
| 0     | 0 | 0         |
| 0     | 1 | 1         |
| 1     | 0 | 1         |
| 1     | 1 | 0         |

\*

\*\*

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

Excitation Table

31 THURSDAY  
Week 44 • 304/061

| $Q_n$ | $Q_{n+1}$ | T |
|-------|-----------|---|
| 0     | 0         | 0 |
| 0     | 1         | 1 |
| 1     | 0         | 1 |
| 1     | 1         | 0 |

NOTES



Ckt of T Flip Flop :-

