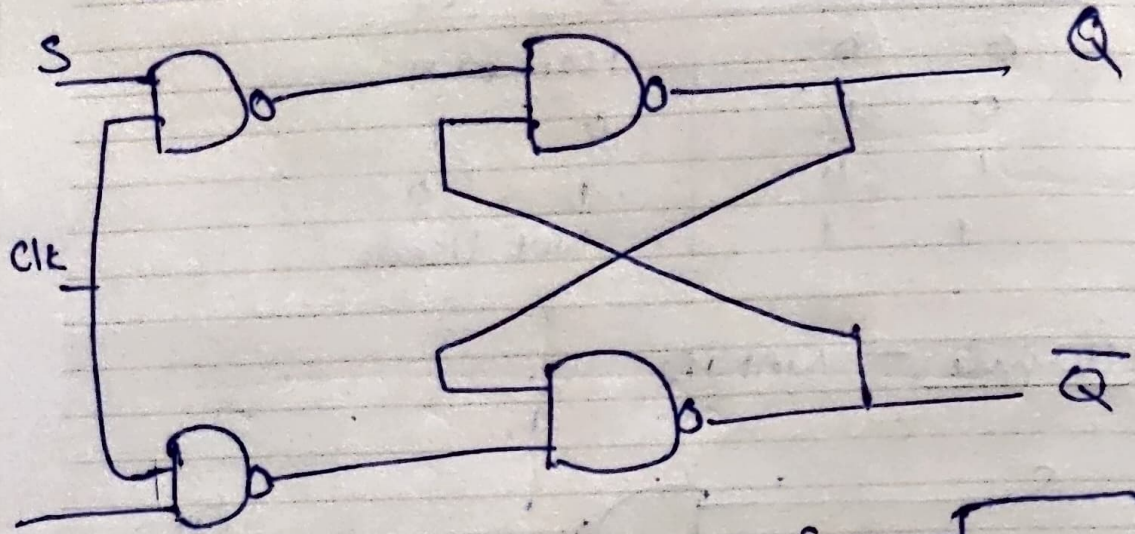


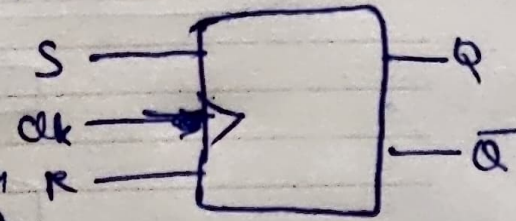
# NOTES

## SR Latch Flip Flop



TRUTH TABLE

CLK	S	R	Q	Q̄	Q <sub>n+1</sub>
0	x	x	Memory	Memory	Q <sub>n</sub>
1	0	0	Memory	Memory	Q <sub>n</sub>
1	0	1	0	1	0
1	1	0	1	0	1
1	1	1	Not Used	Not Used	Invalid



CHARACTERISTIC TABLE

Q <sub>n</sub>	S	R	Q <sub>n+1</sub>
0	0	0	0 → mem
0	0	1	0
0	1	0	1
0	1	1	x
1	0	0	1 → mem
1	0	1	0
1	1	0	1
1	1	1	x



# Monthly Planner

October 2008

1 Wed

Excitation Table

2 Thu

3 Fri

4 Sat

5 Sun

6 Mon

7 Tue

8 Wed

9 Thu

10 Fri

11 Sat

12 Sun

13 Mon

14 Tue

15 Wed

16 Thu

17 Fri

18 Sat

19 Sun

20 Mon

21 Tue

22 Wed

23 Thu

24 Fri

25 Sat

26 Sun

27 Mon

28 Tue

29 Wed

30 Thu

31 Fri

$Q_n$	$Q_{n+1}$	S	R
0	0	0	x
0	1	1	0
1	0	0	1
1	1	x	0

~~12 Nov~~

$Q_n$	00	01	11	10	$Q_{n+1}$
0	0	0	x	1	
1	1	0	x	1	

II I

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

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

☆☆☆

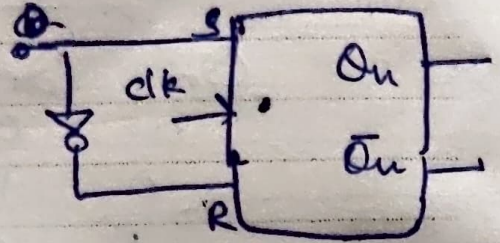
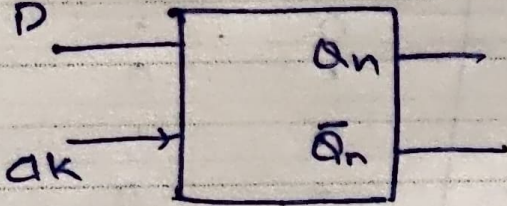




WEDNESDAY

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OCTOBER 2008

D - Flip-flop (Data)

clk	D	Q <sub>n+1</sub>	Truth table
0	X	Q <sub>n</sub>	
1	0	0	
1	1	1	

Combining S & R  $\rightarrow$  D  
~~S~~  $\rightarrow$  D  
~~R~~  $\rightarrow$  D



THURSDAY

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Characteristic table

Q <sub>n</sub>	D	Q <sub>n+1</sub>
0	0	0
0	1	1
1	0	0
1	1	1

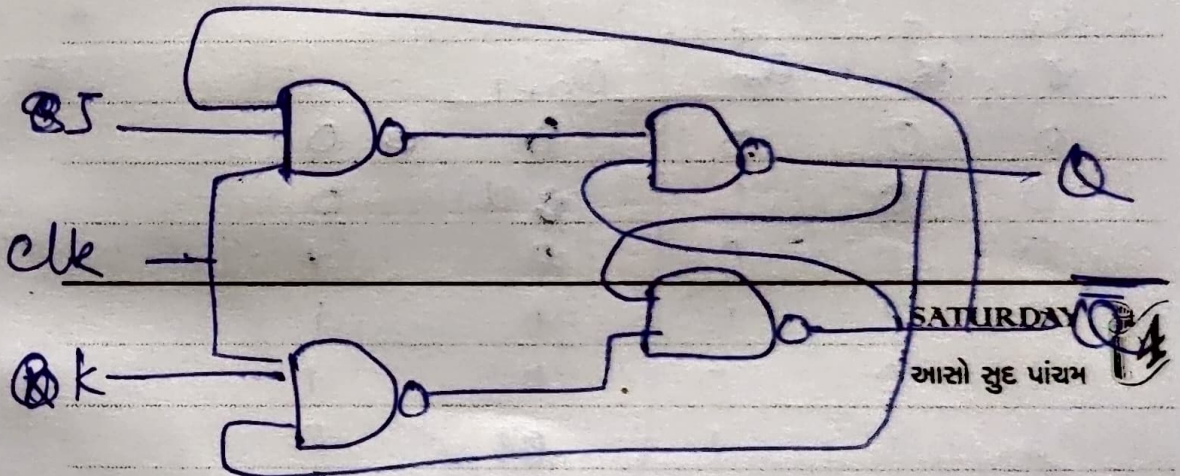
$$Q_{n+1} = D$$





Excitation table

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

JK - Flip flop

$clk = 0 \rightarrow \text{Memory}$

$clk = 1, J = 1, K = 0 \rightarrow Q = 1, \bar{Q} = 0$

$clk = 1, J = 0, K = 1 \rightarrow Q = 0, \bar{Q} = 1$

$clk = 1, J = 1, K = 1$

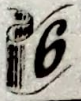
Assume  $Q = 0, \bar{Q} = 1$

$Q = 0, 0, 1, 0, 1, \dots$

$\bar{Q} = 1, 0, 1, 0, \dots$

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





MONDAY

OCTOBER 2008

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Truth table

clk	J	K	$Q_{n+1}$
0	x	x	$Q_n$ } memory
1	0	0	$Q_n$ }
1	0	1	0
1	1	0	1
1	1	1	$\bar{Q}_n$ (toggle)

Characteristic table

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



TUESDAY

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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



$Q_n$   $Q_{n+1}$ 

	0	1
0	0	1
1	x	x

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

for J

 $Q_n$   $Q_{n+1}$ 

	0	1
0	x	x
1	1	0

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

for K

 $Q_n$  JK

	00	01	11	10
0	0	0	1	1
1	1	0	0	1

for  $Q_{n+1}$ 

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

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





FRIDAY

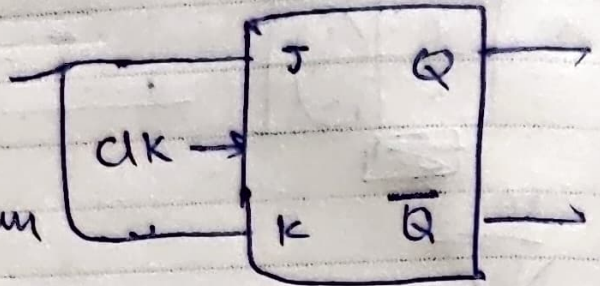
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## T-Flip flop

Truth-table

clk	T	Q <sub>n+1</sub>
0	x	Q <sub>n</sub> } mem
1	0	Q <sub>n</sub>
1	1	$\bar{Q}_n$ } Toggle

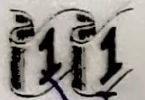


### Characteristic table

Q <sub>n</sub>	T	Q <sub>n+1</sub>
0	0	0
0	1	1
1	0	1
1	1	0

### Excitation table

Q <sub>n</sub>	Q <sub>n+1</sub>	T
0	0	0
0	1	1
1	0	1
1	1	0



SATURDAY

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odd 1's detector

	0	1
0	0	1
1	1	0

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

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

## Flip Flop Conversion

1. Identify available & required ff
2. characteristic table  $\rightarrow$  required ff
3. excitation table  $\rightarrow$  available ff
4. write boolean exp. for available ff

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5. Draw the circuit.



$Jk \rightarrow D$ Flip flop

① Available  $\rightarrow Jk FF$   
 Required  $\rightarrow D FF$

②③

$Q_n$	$D$	$Q_{n+1}$	$J$	$K$
0	0	0	0	x
0	1	1	1	x
1	0	0	x	1
1	1	1	x	0

Inputs Outputs

④

**J**

$Q_n \backslash D$	0	1
0	0	1
1	x	x

**K**

$Q_n \backslash D$	0	1
0	x	x
1	1	0

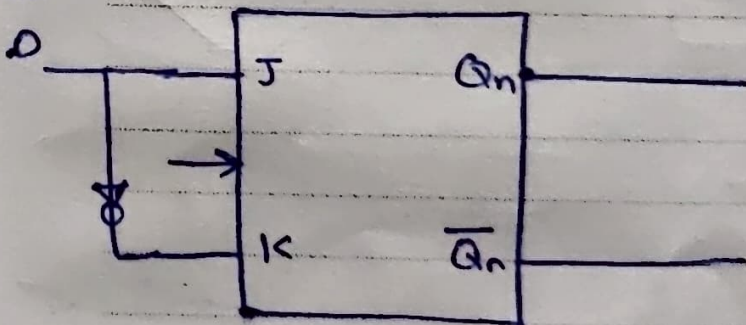
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$$J = D$$

$$K = \bar{D}$$

⑤



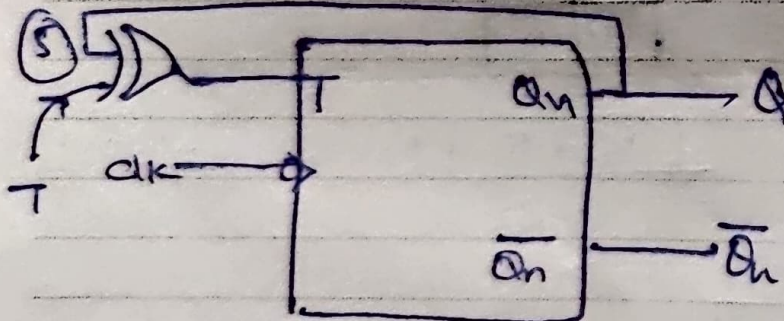
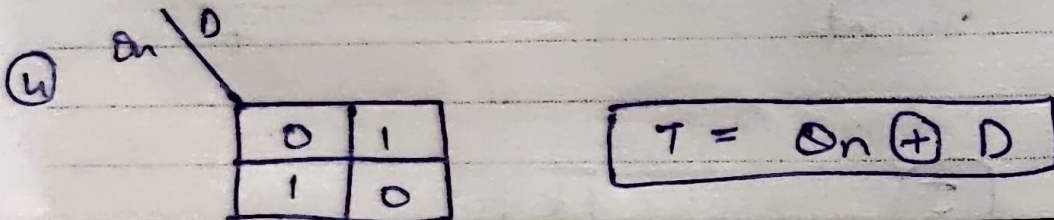


# T → D Flip-flop

- ① Available - T  
Required - D

②

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





SR → JKFlipFlop

1) Available - SR  
Required - JK

2) 3)

$Q_n$	J	K	$Q_{n+1}$	S	R
0	0	0	0	0	x
0	0	1	0	0	x
0	1	0	1	1	0
0	1	1	1	1	0
1	0	0	1	x	0
1	0	1	0	0	1
1	1	0	1	x	0
1	1	1	0		

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4)

$Q_n$	JK	00	01	11	10
0		0	0	1	1
1		x	0	0	x

not needed

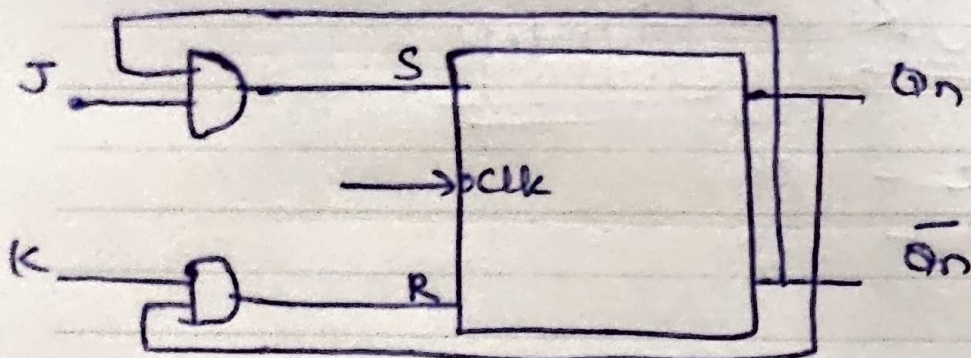
$$S = \overline{Q_n} J + Q_n \overline{K}$$

$Q_n$	JK	00	01	11	10
0		x	x	0	0
1		0	1	1	0

not needed

$$R = \overline{Q_n} \overline{J} + Q_n K$$





SR flip flop from JK

SR  $\rightarrow$  T FlipFlop

Available  $\rightarrow$  SR  
Required  $\rightarrow$  T

Qn	T	Qn+1	S	R
0	0	0	0	X
0	1	1	1	0
1	0	1	X	0
1	1	0	X	1

S

Qn \ T	0	1
0	0	1
1	X	0

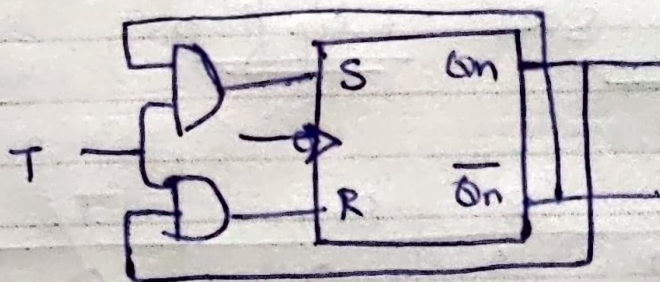
R

Qn \ T	0	1
0	X	0
1	0	1

$S = \overline{Q_n}T$

$R = Q_nT$





# JK $\rightarrow$ SR flip flop

$Q_n$	S	R	$Q_{n+1}$	J	K
0	0	0	0	0	x
0	0	1	0	0	x
0	1	0	1	1	x
0	1	1	x	x	x
1	0	0	1	x	0
1	0	1	0	x	1
1	1	0	1	x	x
1	1	1	x	x	x

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J

$Q_n$	SR	00	01	11	10
0	0	0	0	x	1
1	1	x	x	x	x

K

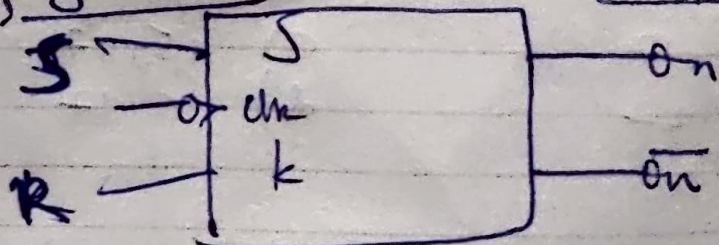
$Q_n$	SR	00	01	11	10
0	0	x	x	x	x
1	1	0	1	x	0

$J = \overline{Q_n} S R$

$J = S$

$K = Q_n \overline{S} R$

$K = R$







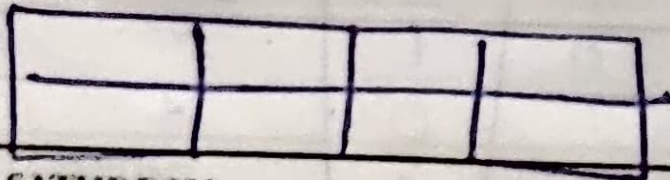
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T  $\rightarrow$  SR Flip flop

<u>Qn</u>	<u>S</u>	<u>R</u>	<u>Qn+1</u>	<u>T</u>
0	0	0	0	0
0	0	1	0	0
0	1	0	1	1
0	1	1	X	X
1	0	0	1	0
1	0	1	0	1
1	1	0	1	0
1	1	1	X	X



SATURDAY