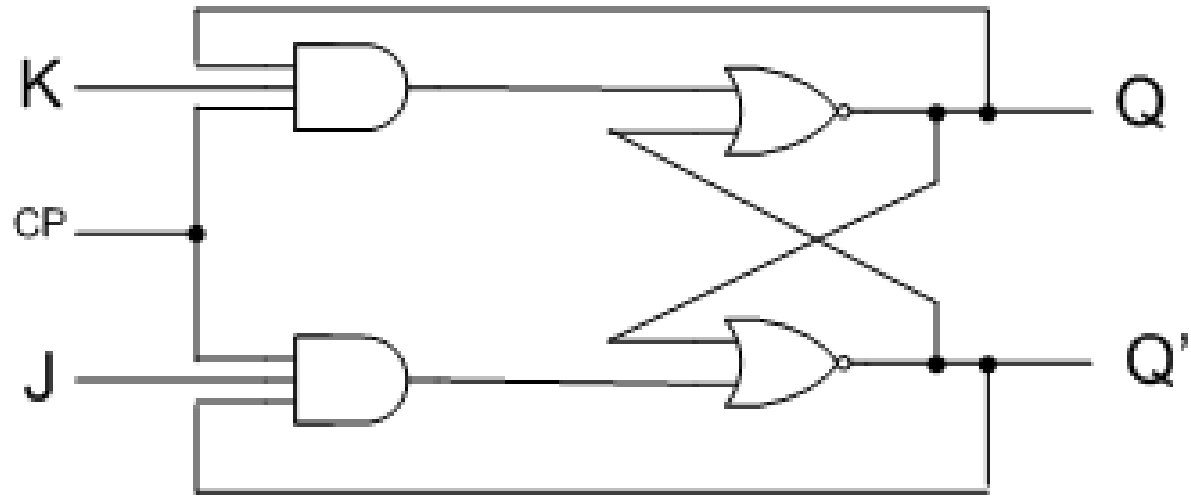


# JK Flip-flop

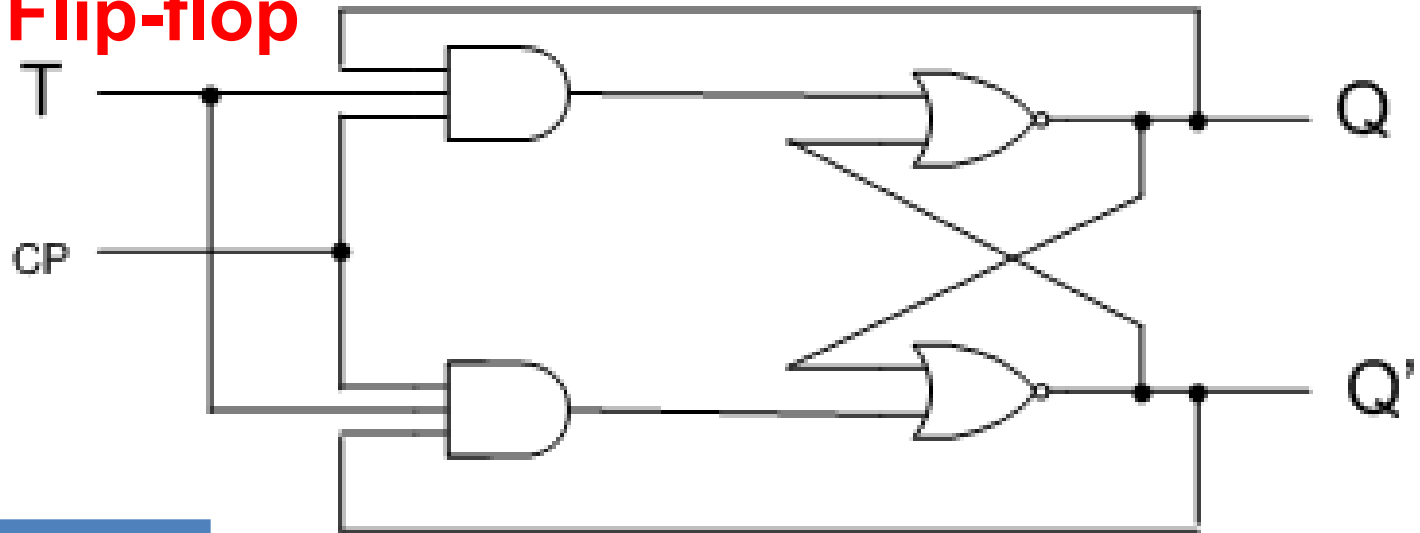


Q	J	K	Q(t+1)
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

$$Q(t+1) = J\bar{Q}(t) + \bar{K}Q(t)$$

JK flip flop is refinement of RS flip flop where indeterminate state of RS flip flop is defined in JK Flip Flop.

## Toggle or T Flip-flop



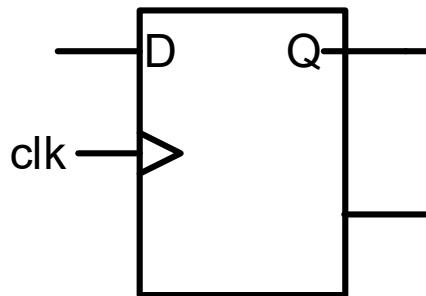
Q	T	Q(t+1)
0	0	0
0	1	1
1	0	1
1	1	0

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

# Characteristic table

Given a input and the present state of the flip-flop, what is the next state of the flip-flop

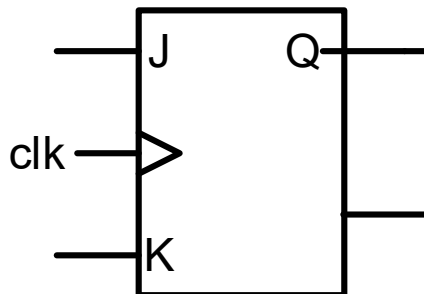
## D Flip-flop



Inputs <b>(D)</b>	Q(t+1)
<b>0</b>	<b>0</b>
<b>1</b>	<b>1</b>

Characteristic equation:  $Q(t+1) = D$

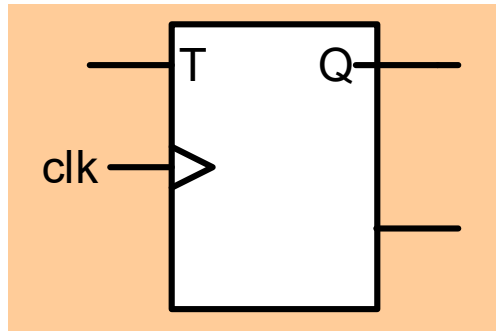
## JK Flip-flop



Inputs <b>J</b>	<b>K</b>	Q(t+1)
<b>0</b>	<b>0</b>	<b>Q(t)</b>
<b>0</b>	<b>1</b>	<b>0</b>
<b>1</b>	<b>0</b>	<b>1</b>
<b>1</b>	<b>1</b>	<b><math>\overline{Q(t)}</math></b>

Characteristic equation:  $Q(t+1) = J\overline{Q}(t) + \overline{K}Q(t)$

# Toggle or T Flip-flop



Inputs (T)	Q(t+1)
0	Q(t)
1	$\overline{Q(t)}$

Characteristic equation:

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

## Excitation Table

What inputs are required to effect a particular state change

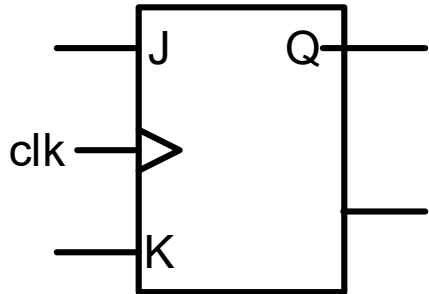
Q	T	Q(t+1)
0	0	0
0	1	1
1	0	1
1	1	0

Excitation Table

Inputs

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

# Excitation Table



J	K	Q(t+1)
0	0	Q(t)
0	1	0
1	0	1
1	1	$\overline{Q(t)}$

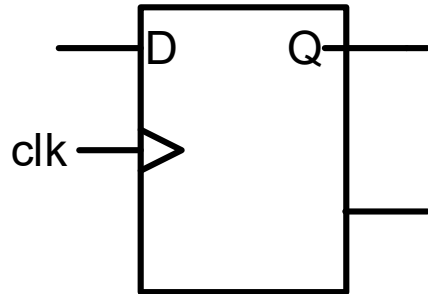
Characteristic Table

		Inputs	
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	J	K	Q(t+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	1
1	1	1	0

# Excitation Table



D	Q(t+1)
0	0
1	1

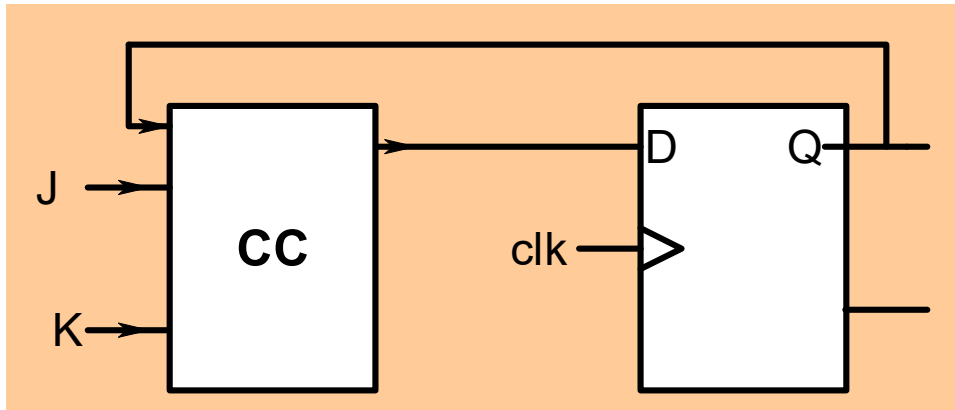
Characteristic Table

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

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

Excitation Table

# Convert a D FF to JK FF



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

Inputs

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

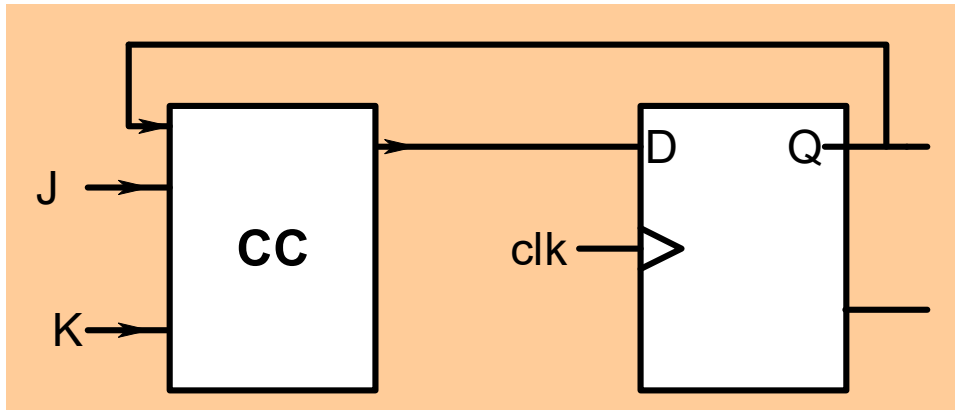
Excitation Table

Inputs

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

Excitation Table

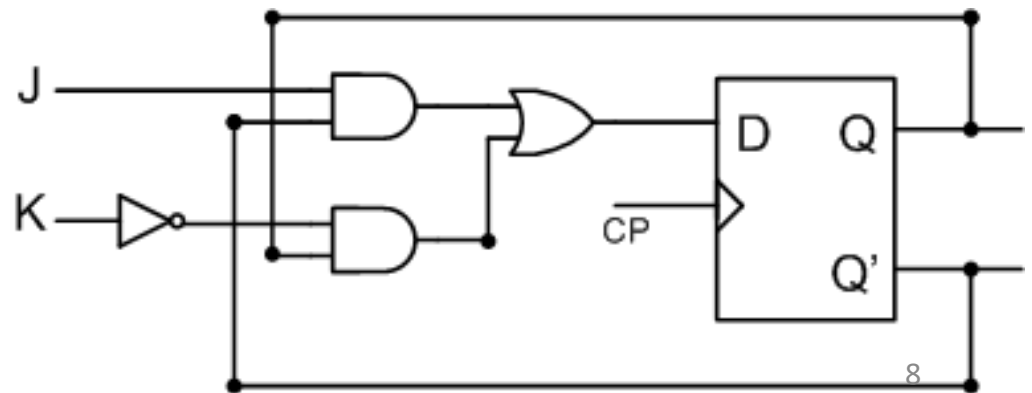
## Convert a D FF to JK FF



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

JK \ Q	00	01	11	10
0			1	1
1	1			1

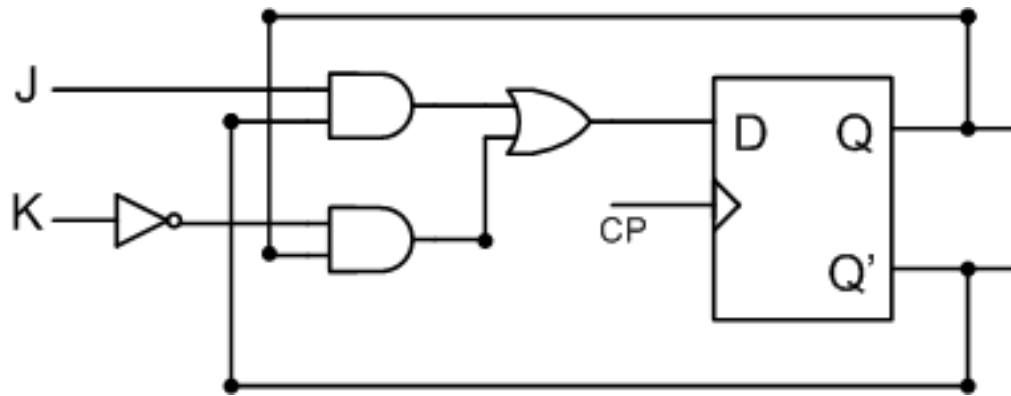
$$D = \bar{Q}.J + Q.\bar{K}$$





## Convert a D FF to JK FF

$$D = \overline{Q}.J + Q.\overline{K}$$



Inputs	J	K	Q(t+1)
	0	0	Q(t)
	0	1	0
	1	0	1
	1	1	$\overline{Q(t)}$

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