CprE 281:
Digital Logic

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TA for Cpr E 281

http://www.ece.iastate.edu/~alexs/classes/

T Flip-Flops
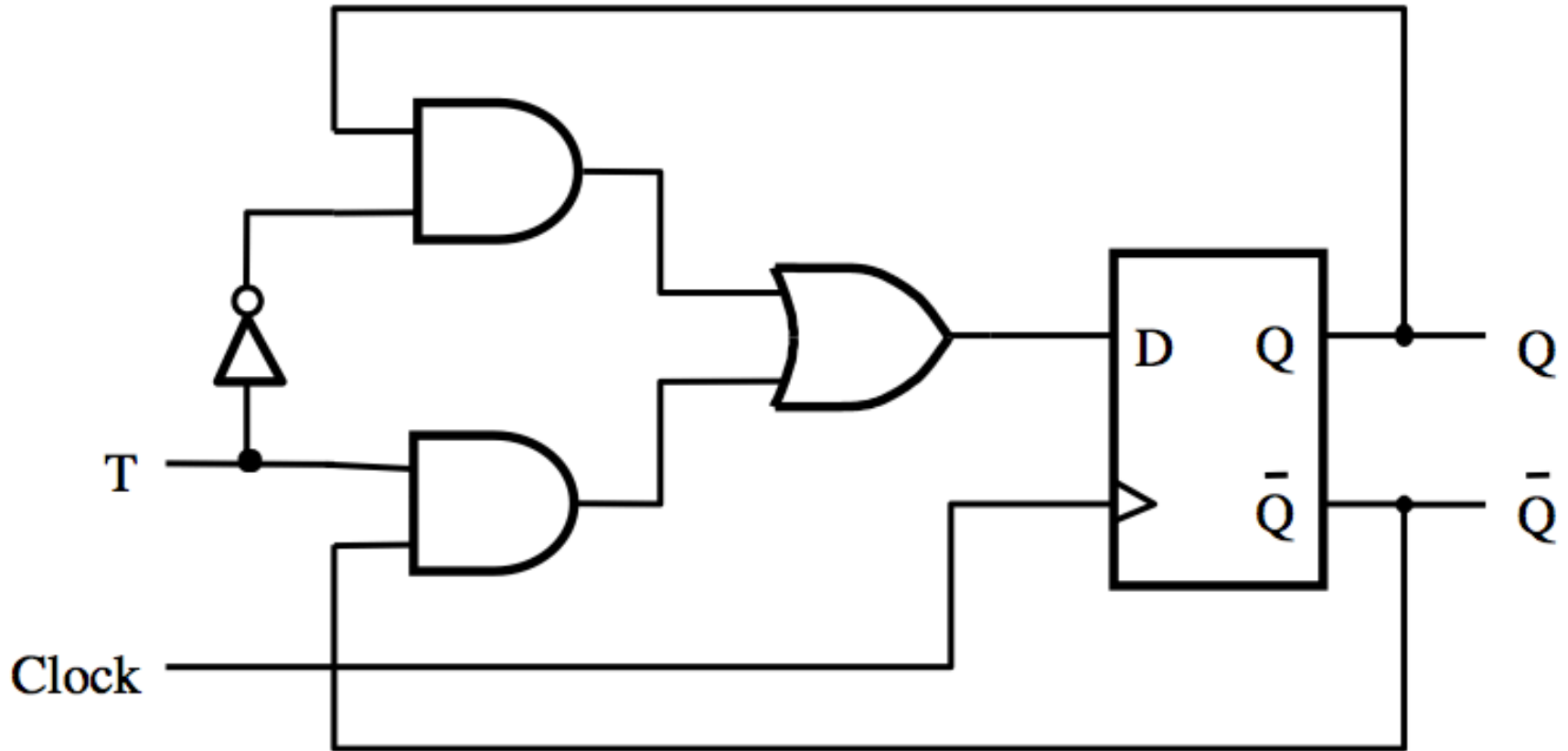# &
JK Flip-Flops

T Flip-Flop

Motivation

A slight modification of the D flip-flop that can be used for some nice applications.
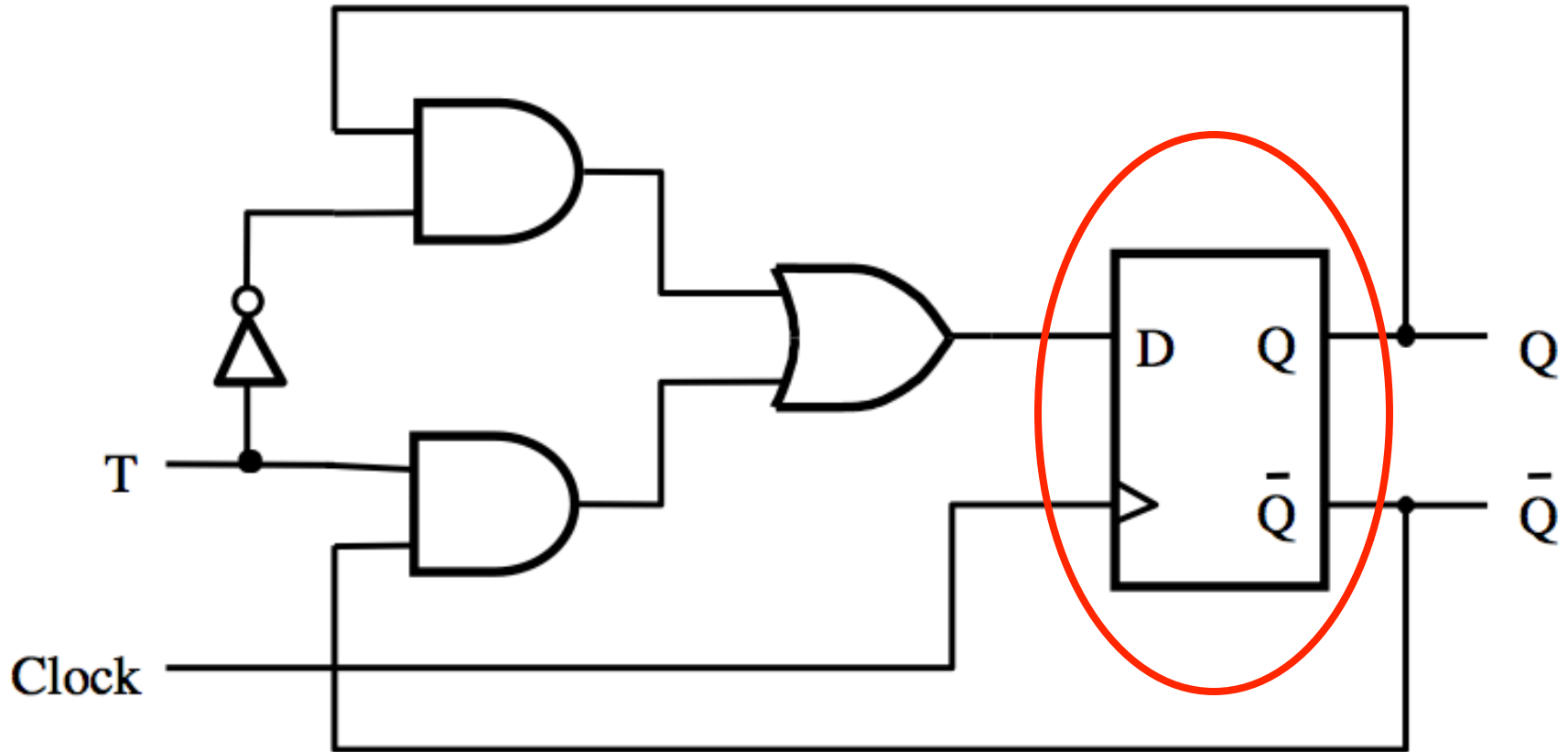
In this case, T stands for Toggle.

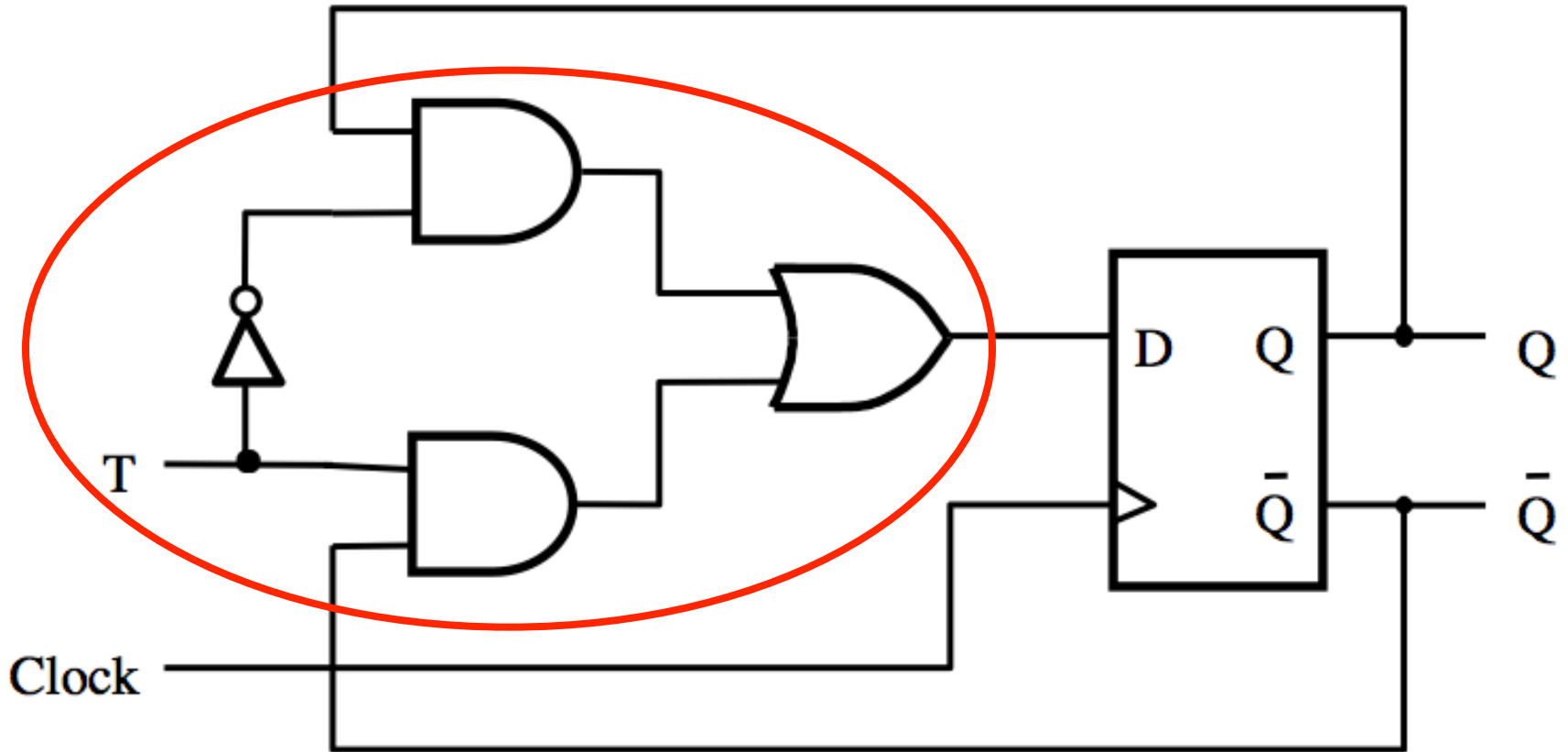# T Flip-Flop

[Figure 5.15a from the textbook]

T Flip-Flop
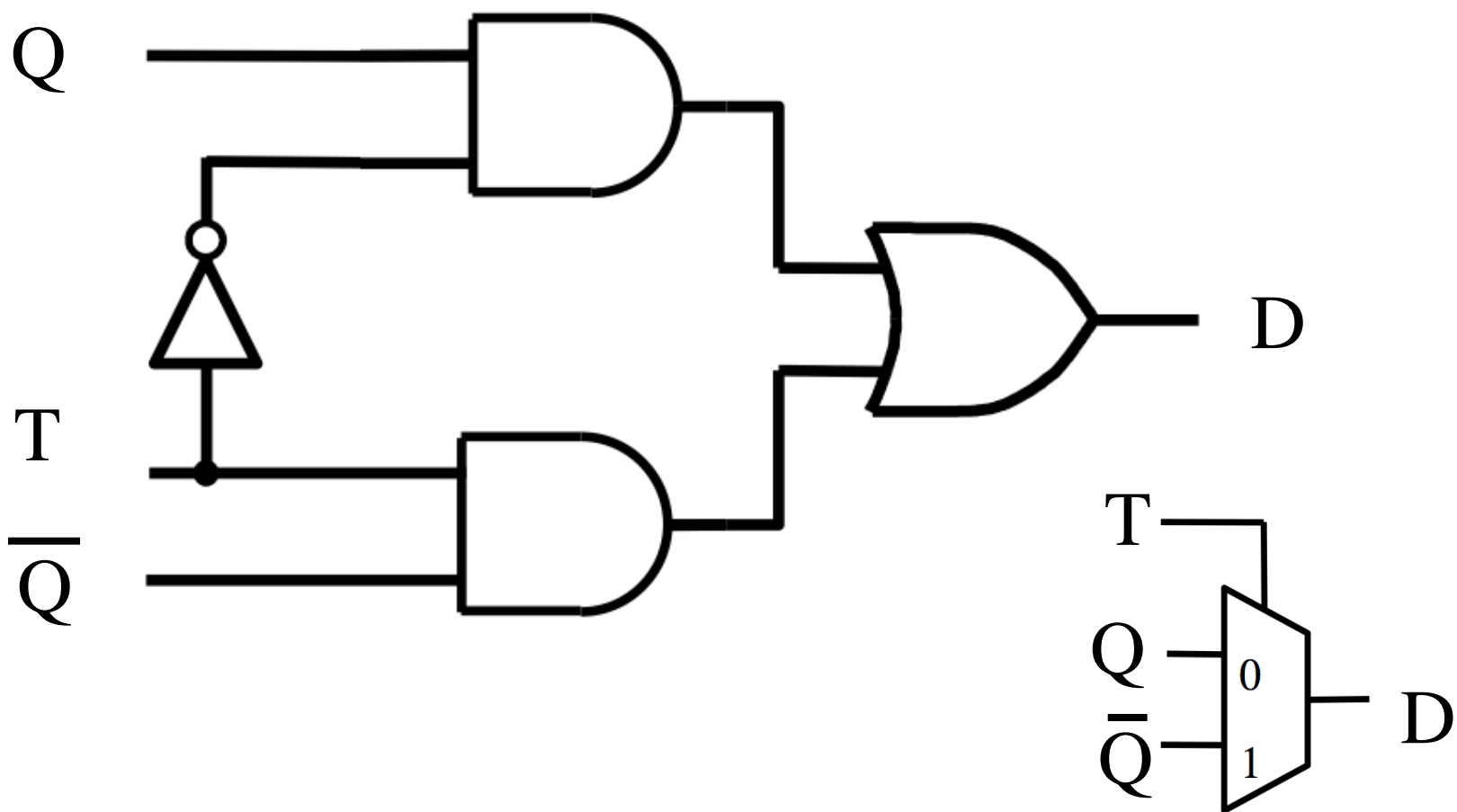

Positive-edge-triggered
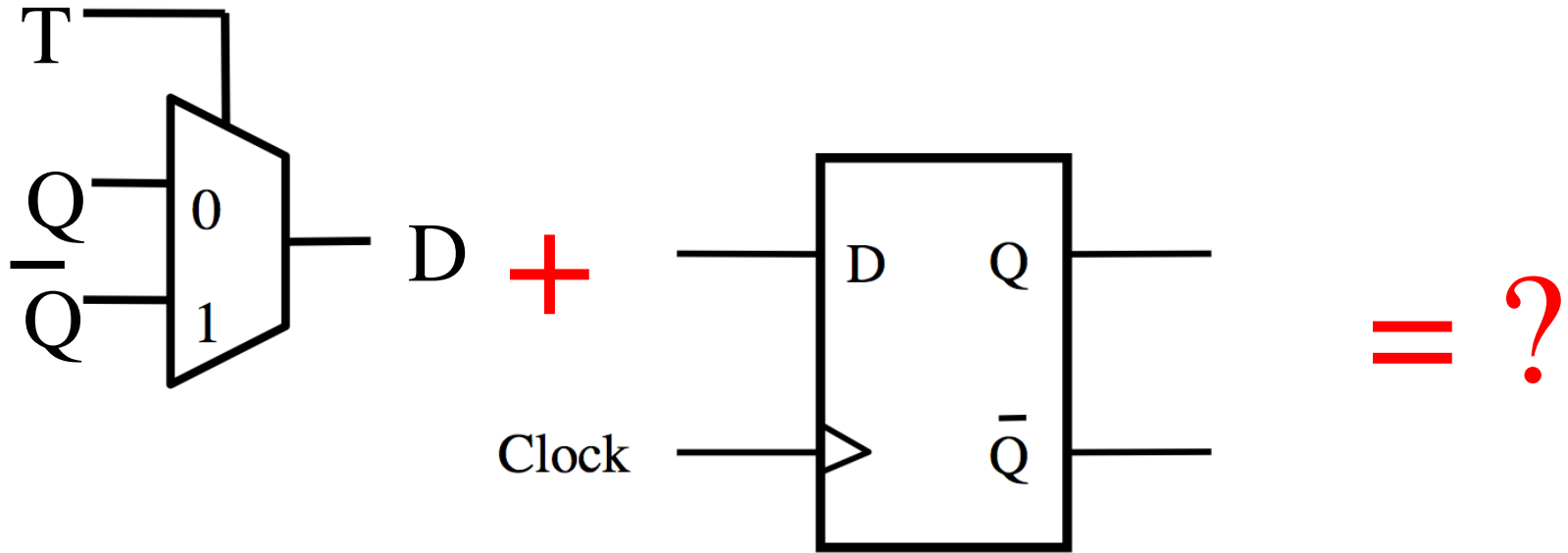D Flip-Flop

[Figure 5.15a from the textbook]

T Flip-Flop

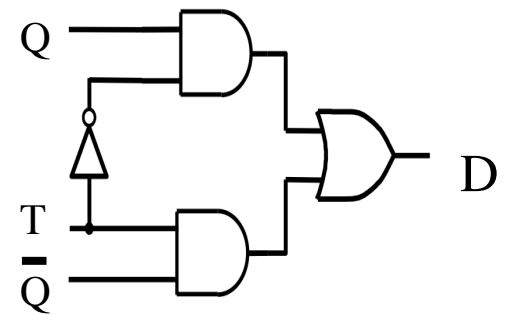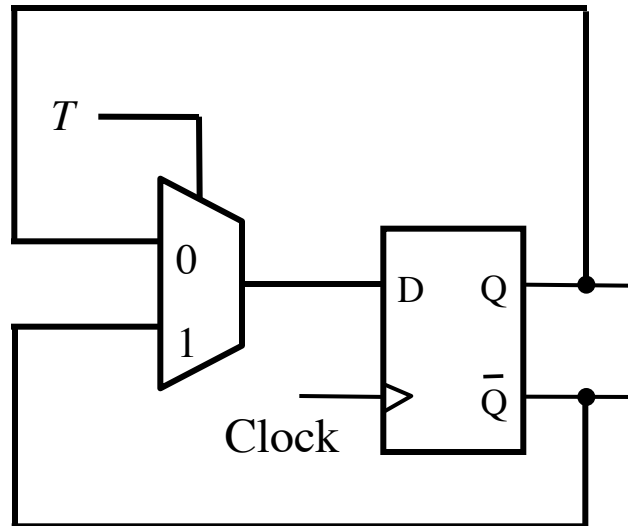What is this?

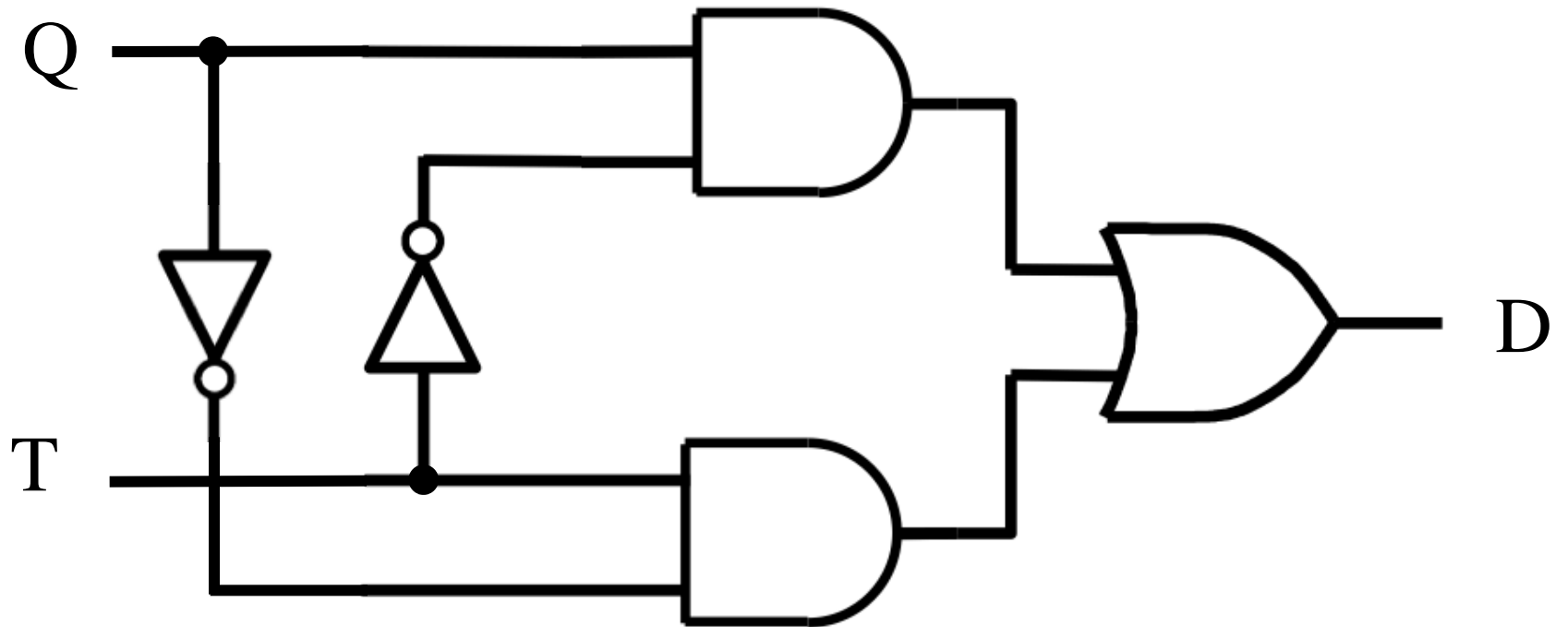[Figure 5.15a from the textbook]
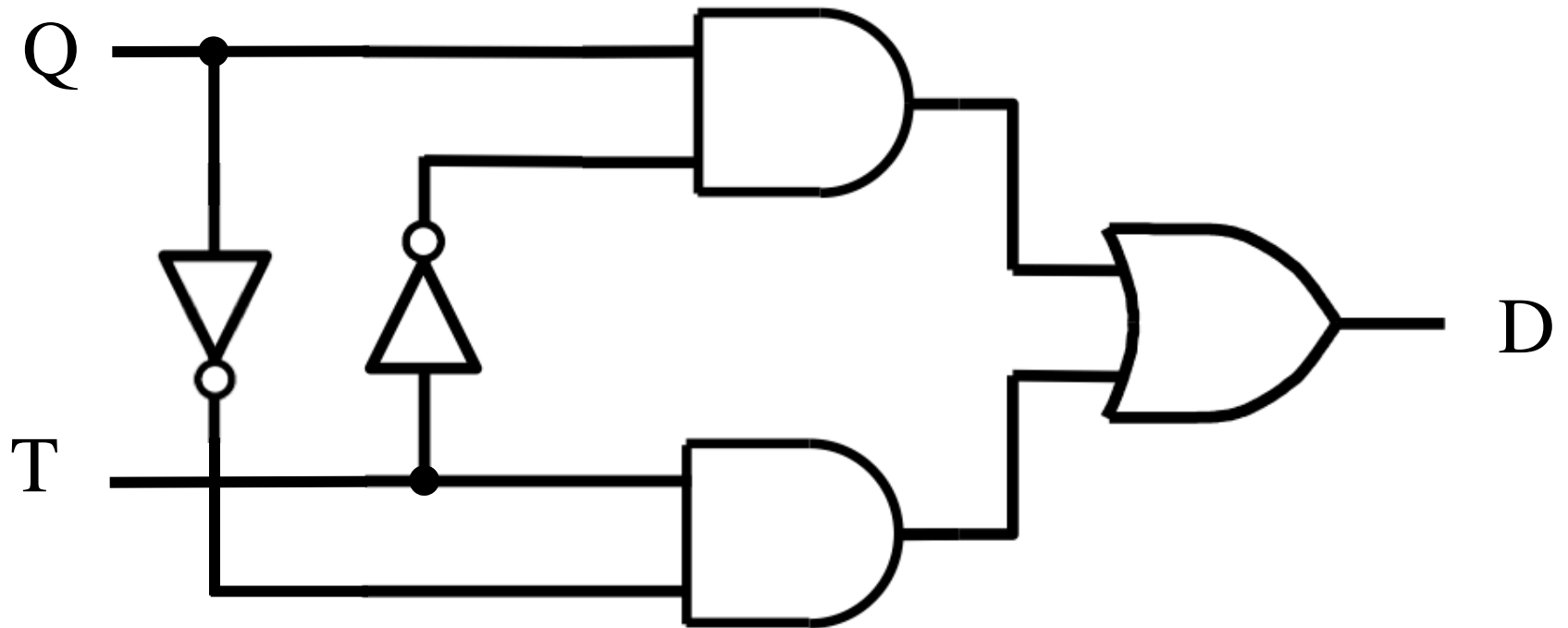
What is this?

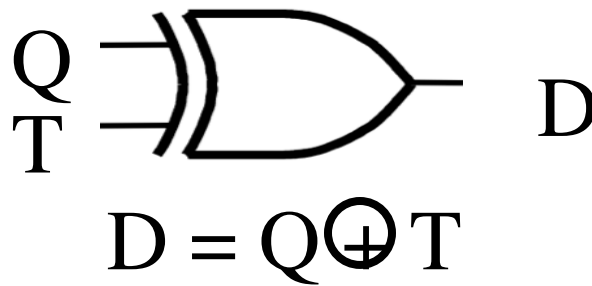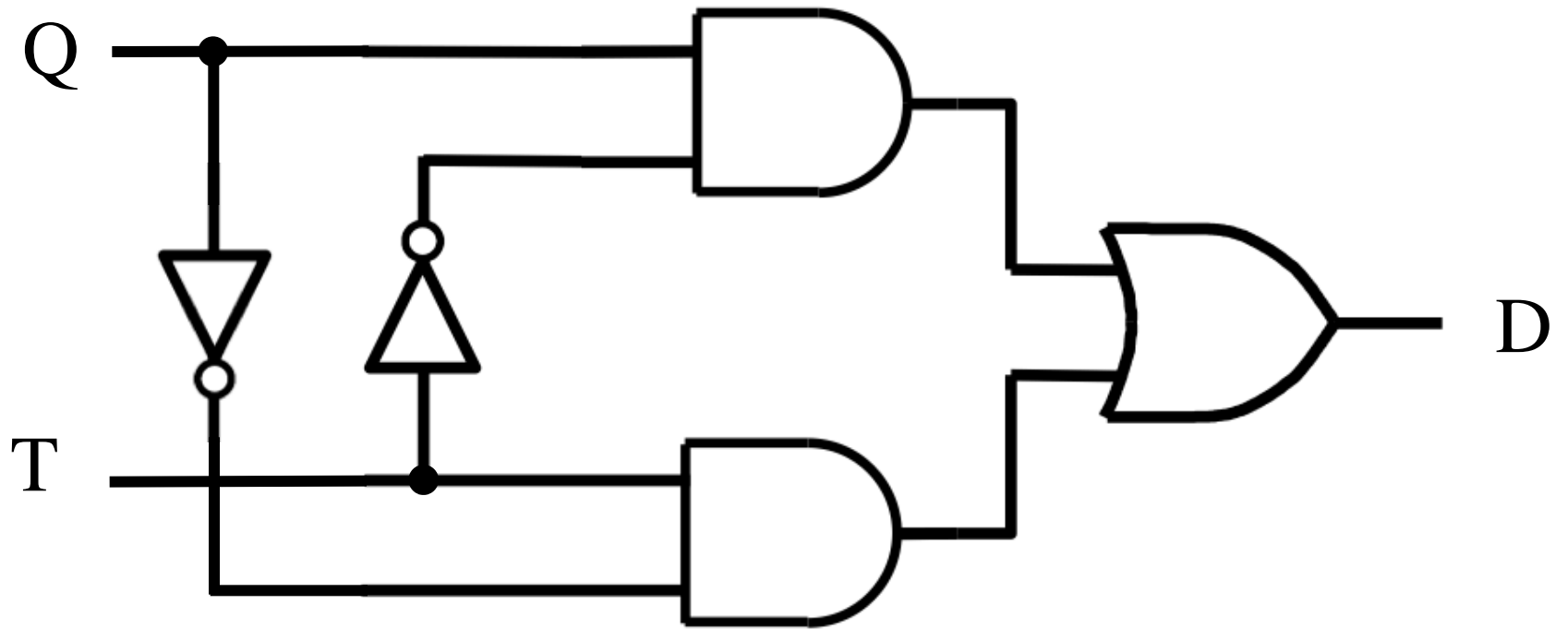# What is this?

T Flip-Flop

What is this?

What is this?

$$D = Q\overline{T} + \overline{Q}T$$

What is this?

$$D = Q \oplus T$$

What is this?
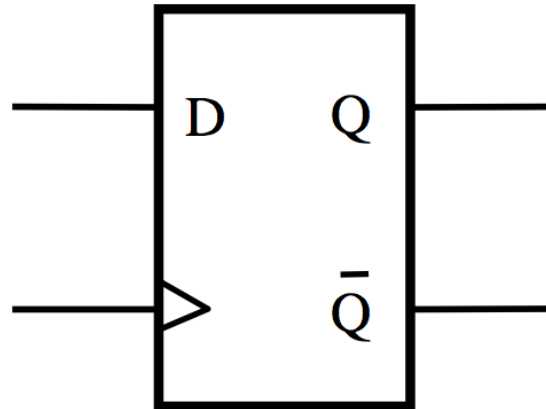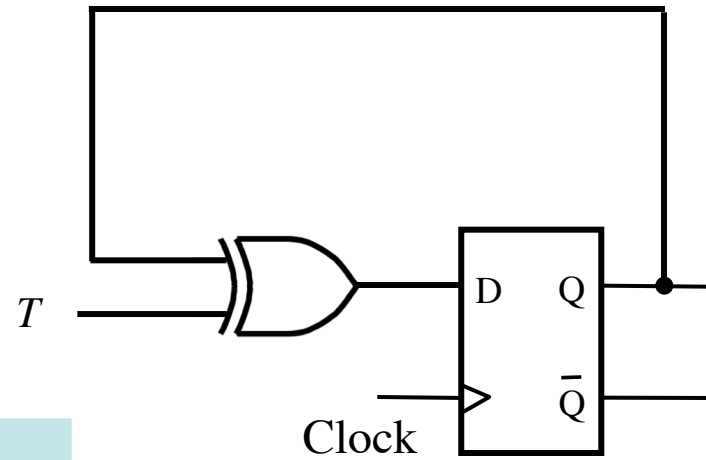
T Flip-Flop

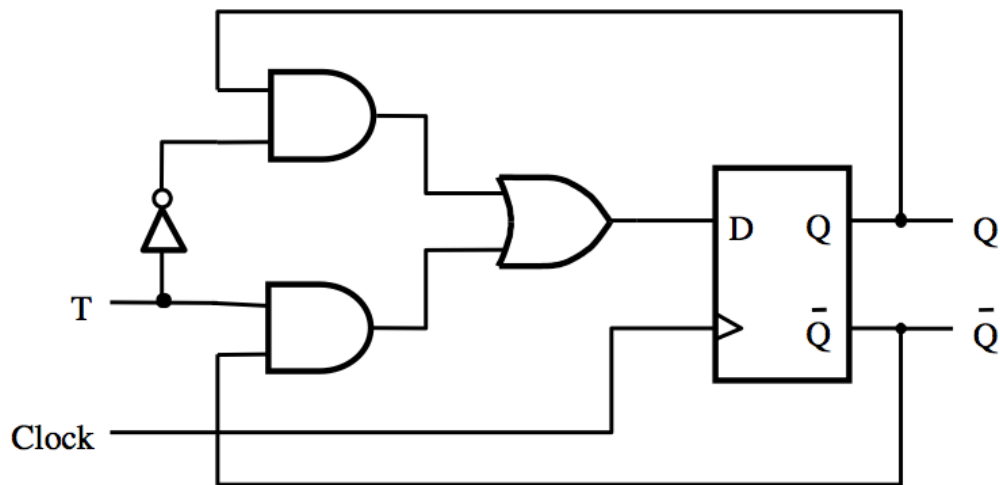| T	Q	D	
0	0	0	Q
0	1	1	
1	0	1	Q'
1	1	0	

T Flip-Flop
(How it Works)

If T=0 then it stays in its current state

If T=1 then it reverses its current state

In other words the circuit "toggles" its state when T=1. This is why it is called T flip-flop.
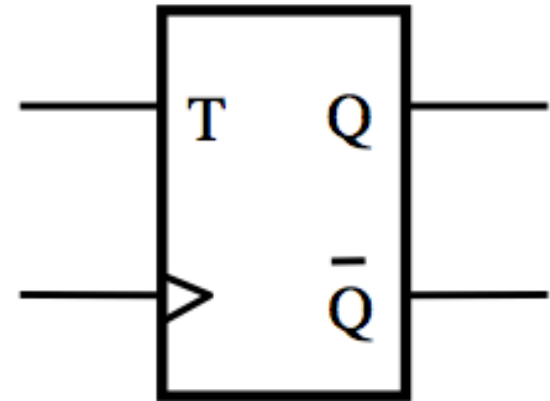
T Flip-Flop
(circuit and truth table)

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

[Figure 5.15a,b from the textbook]

T Flip-Flop
(circuit and graphical symbol)
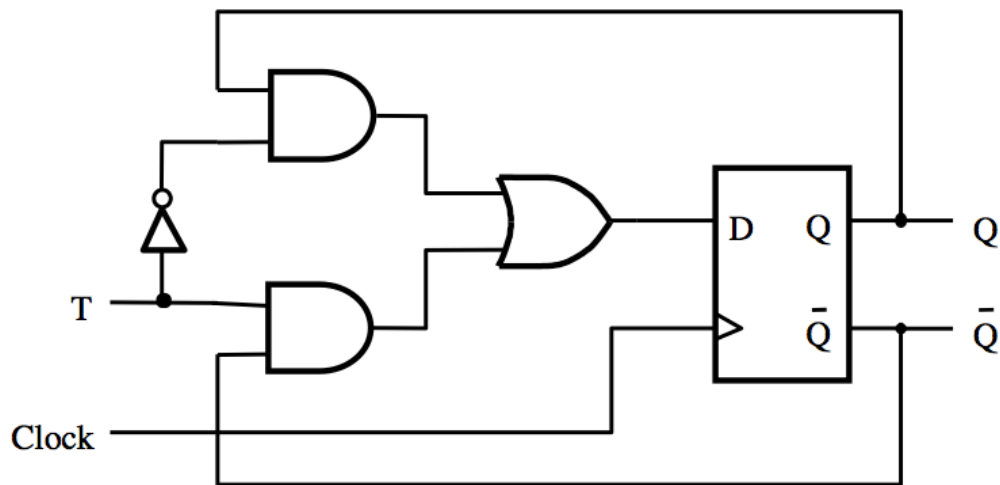
T Flip-Flop (Timing Diagram)

Decision
Point

Clock

T

Q

1

1

0

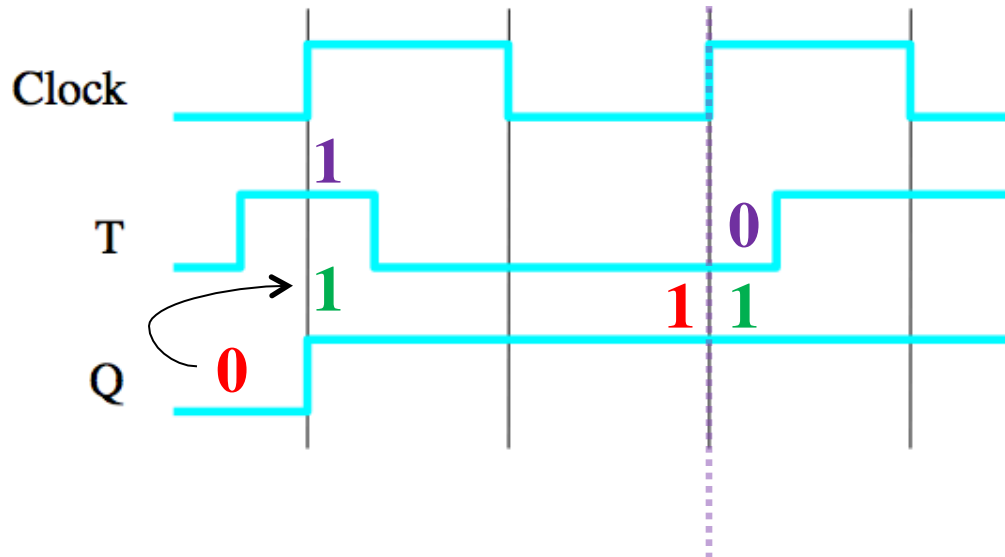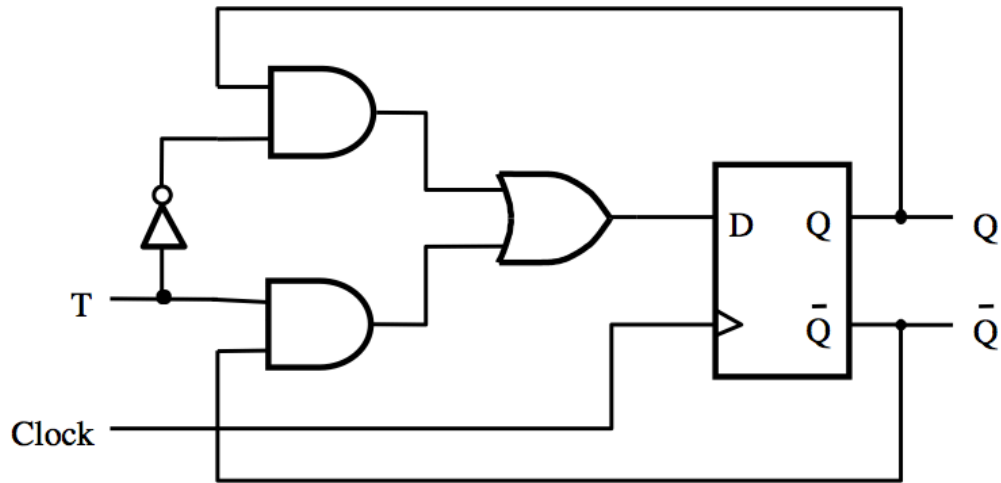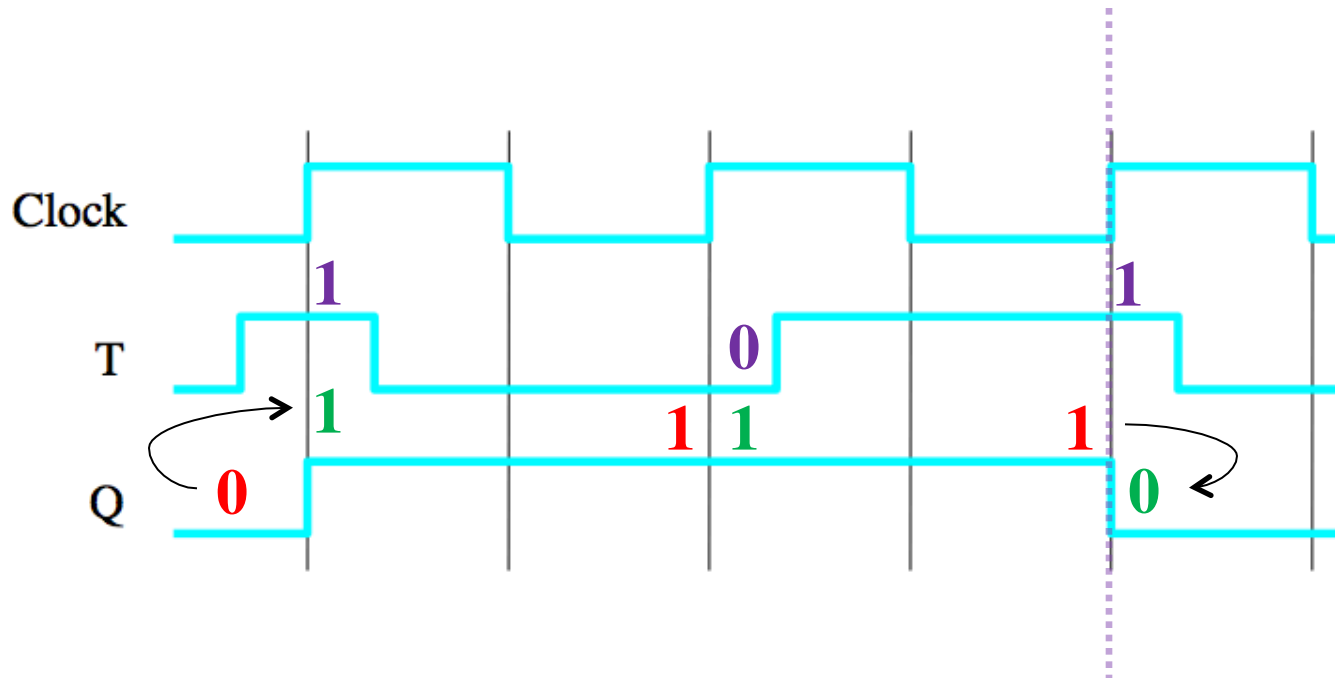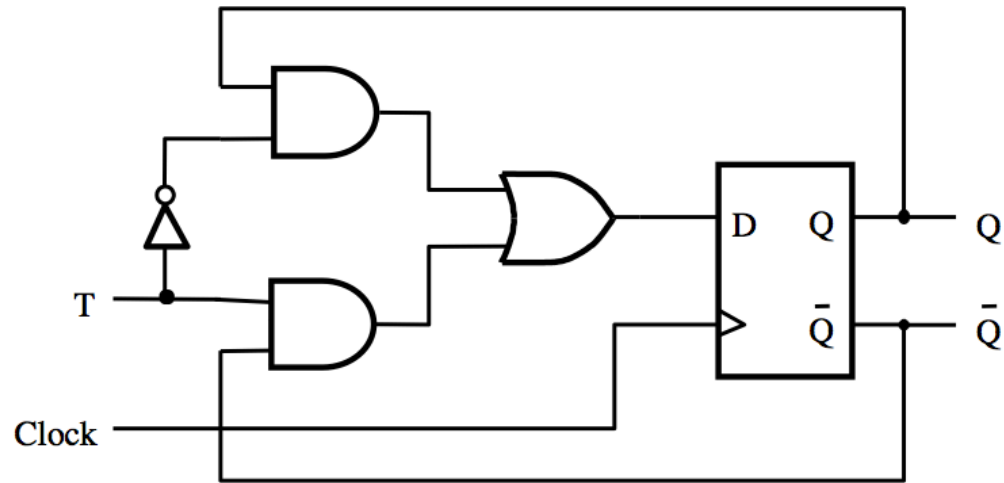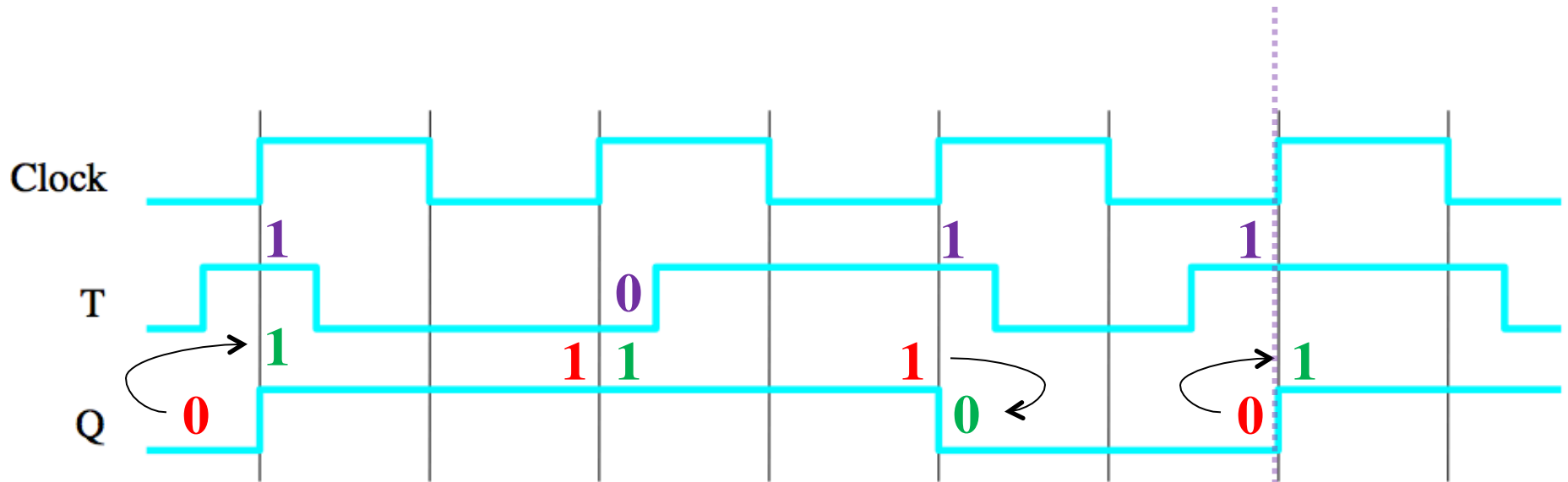[Figure 5.15d from the textbook]

T Flip-Flop (Timing Diagram)

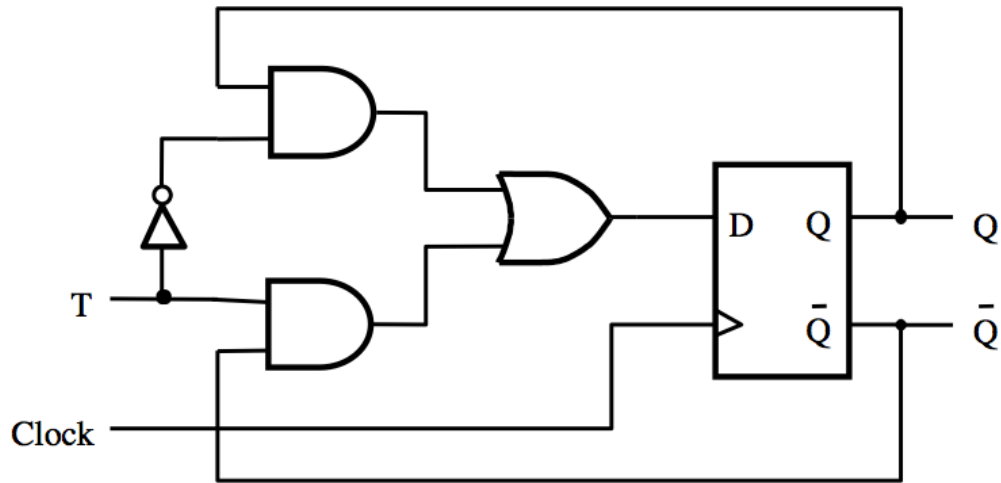[Figure 5.15d from the textbook]

T Flip-Flop (Timing Diagram)

[Figure 5.15d from the textbook]

T Flip-Flop (Timing Diagram)

[Figure 5.15d from the textbook]

JK Flip-Flop

T Flip-Flop

[Figure 5.16a from the textbook]
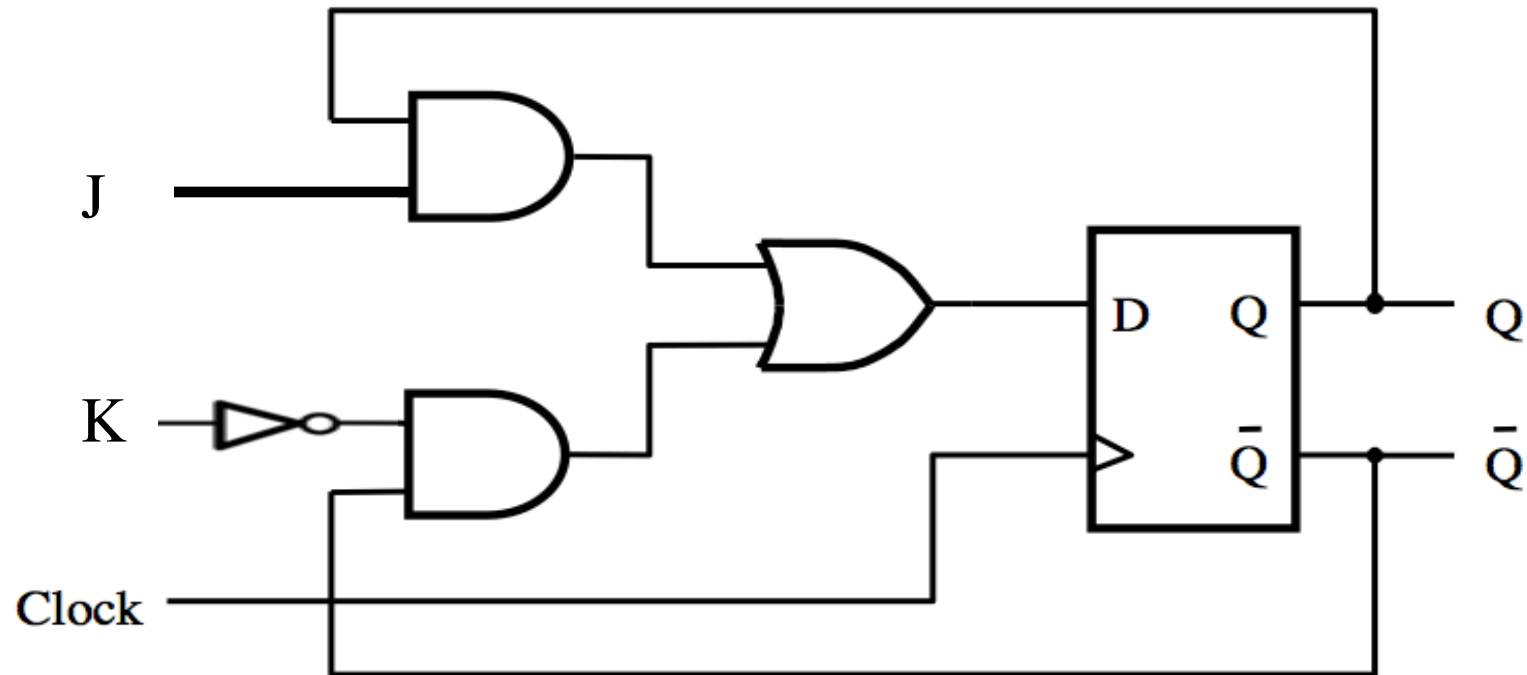
JK Flip-Flop

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

[Figure 5.16a from the textbook]
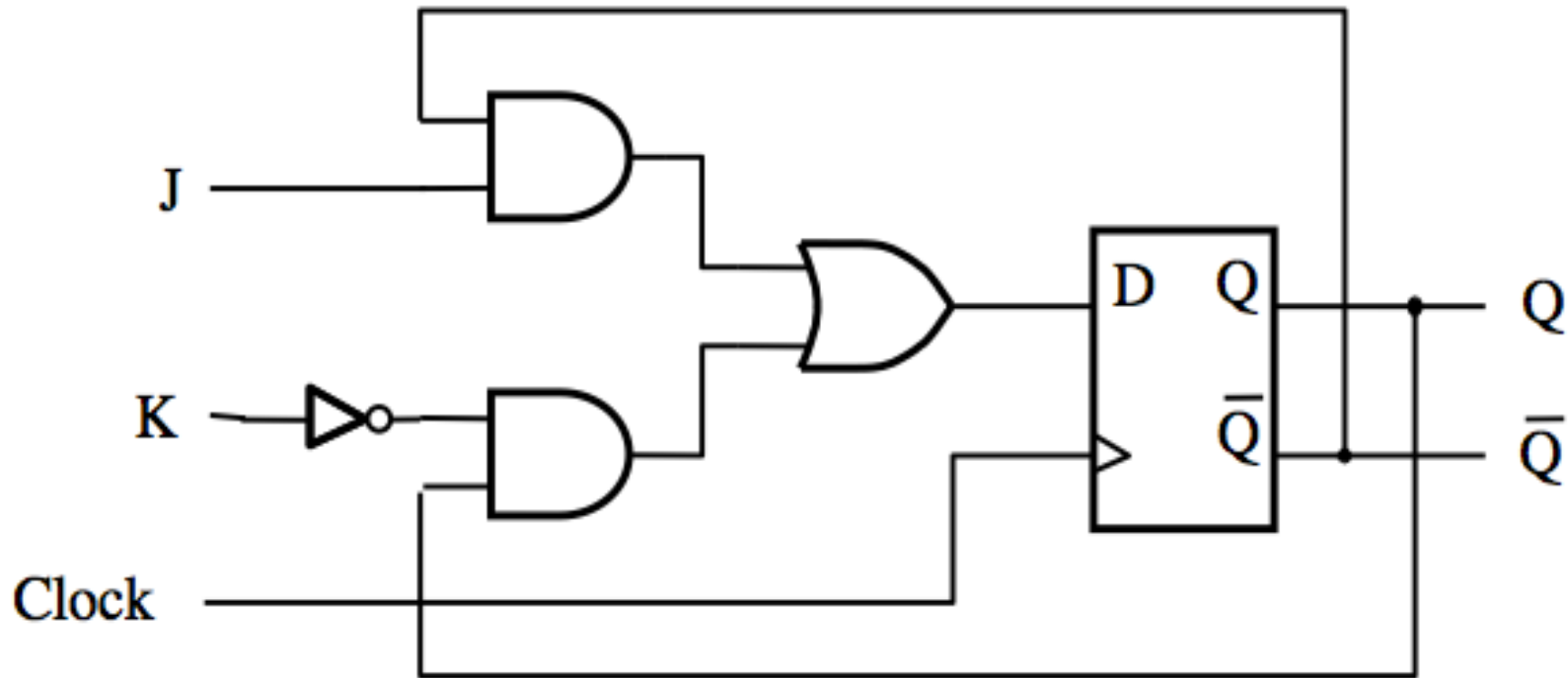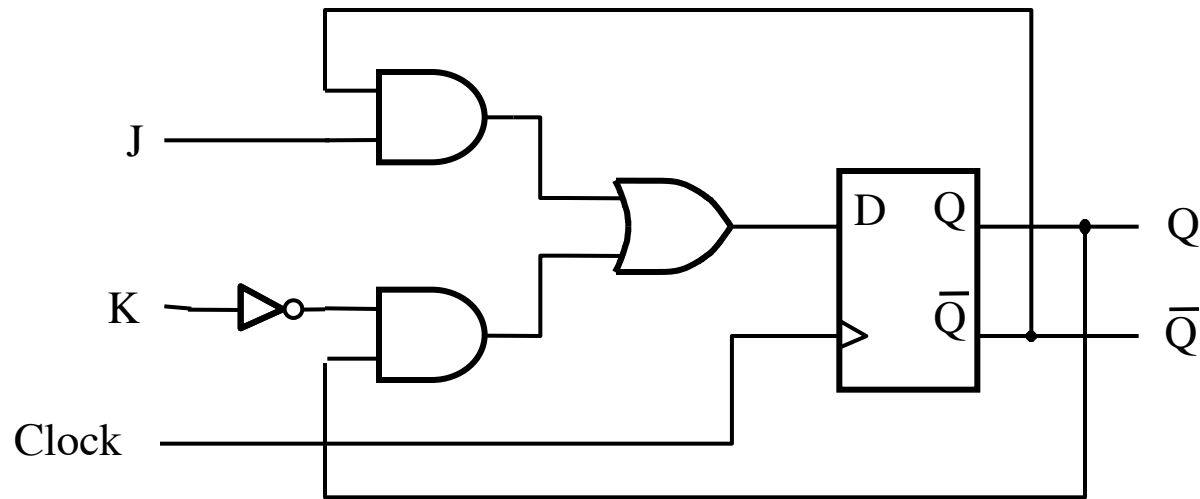
JK Flip-Flop

(a) Circuit

J	K	Q (t+1)	
0	0	Q (t)	Hold
0	1	0	Set
1	0	1	Reset
1	1	$\overline{Q}$ (t)	Toggle

(b) Truth table

(c) Graphical symbol

[Figure 5.16 from the textbook]
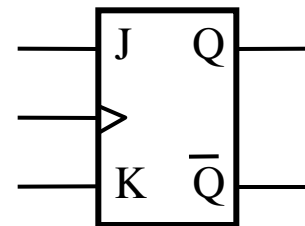
JK Flip-Flop
(How it Works)

A versatile circuit that can be used both as a
SR flip-flop and as a T flip flop

If J=0 and S =0 it stays in the same state

Just like SR It can be set and reset
J=S and K=R

If J=K=1 then it behaves as a T flip-flop

JK Flip-Flop
(How it Works)

clock

J

K

Q

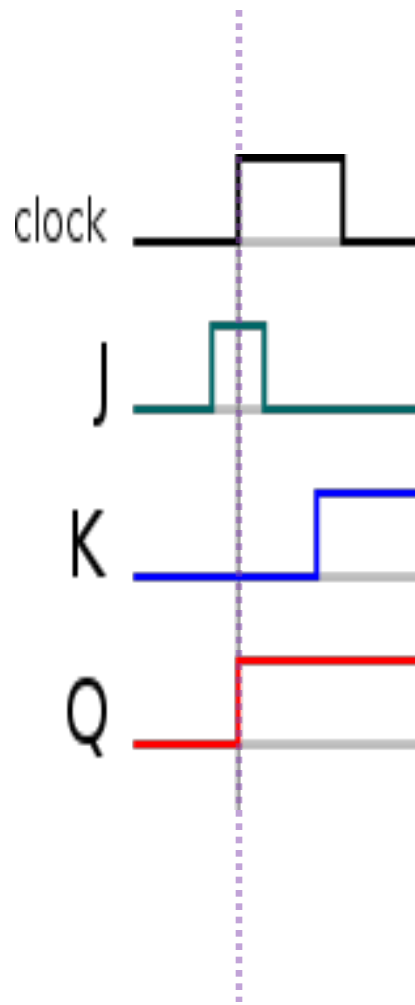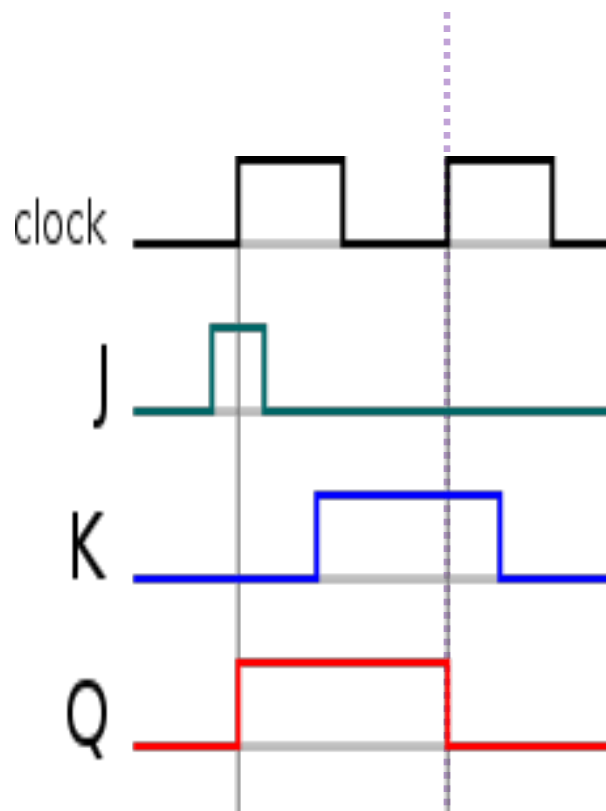| J	K	Q(t+1)	
0	0	Q(t)	Hold
0	1	0	Set
1	0	1	Reset
1	1	$\overline{Q}$(t)	Toggle

JK Flip-Flop
(How it Works)

J	K	Q(t+1)	
0	0	Q(t)	Hold
0	1	0	Set
1	0	1	Reset
1	1	$\overline{Q}$(t)	Toggle

JK Flip-Flop
(How it Works)
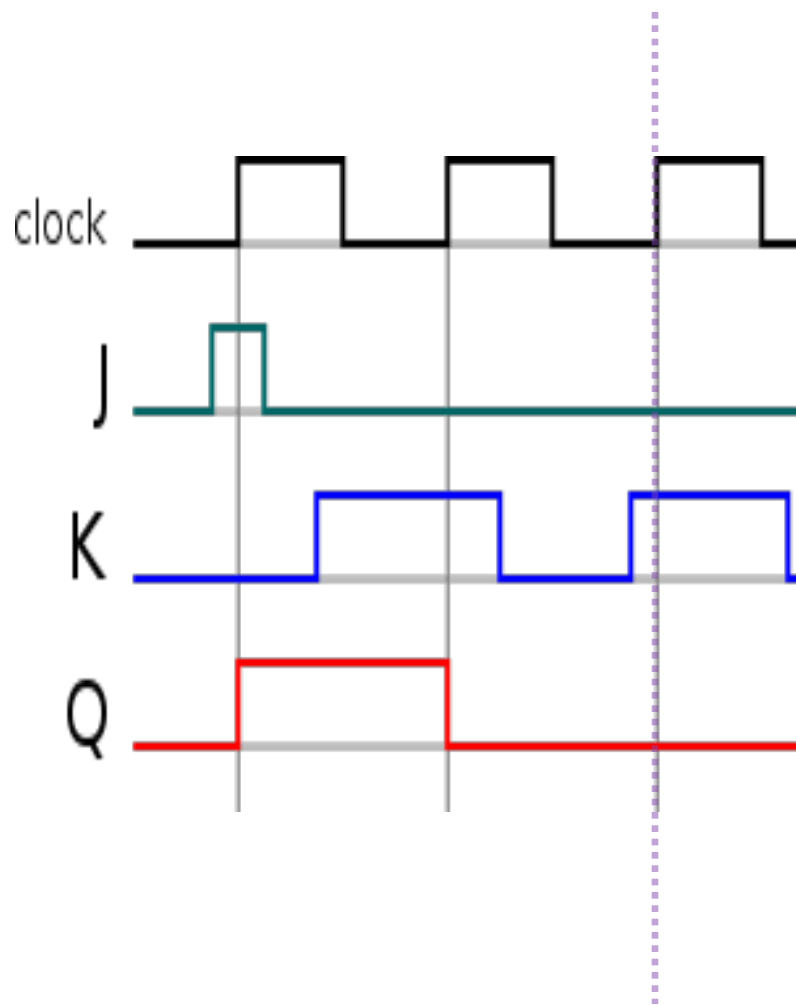
J	K	Q(t+1)	
0	0	Q(t)	Hold
0	1	0	Set
1	0	1	Reset
1	1	$\overline{Q}(t)$	Toggle

JK Flip-Flop
(How it Works)

J	K	Q(t+1)	
0	0	Q(t)	Hold
0	1	0	Set
1	0	1	Reset
1	1	$\overline{Q}(t)$	Toggle

Questions?

Draw the wave form of Q for a (-ve edge) JK flip-flop

THE END