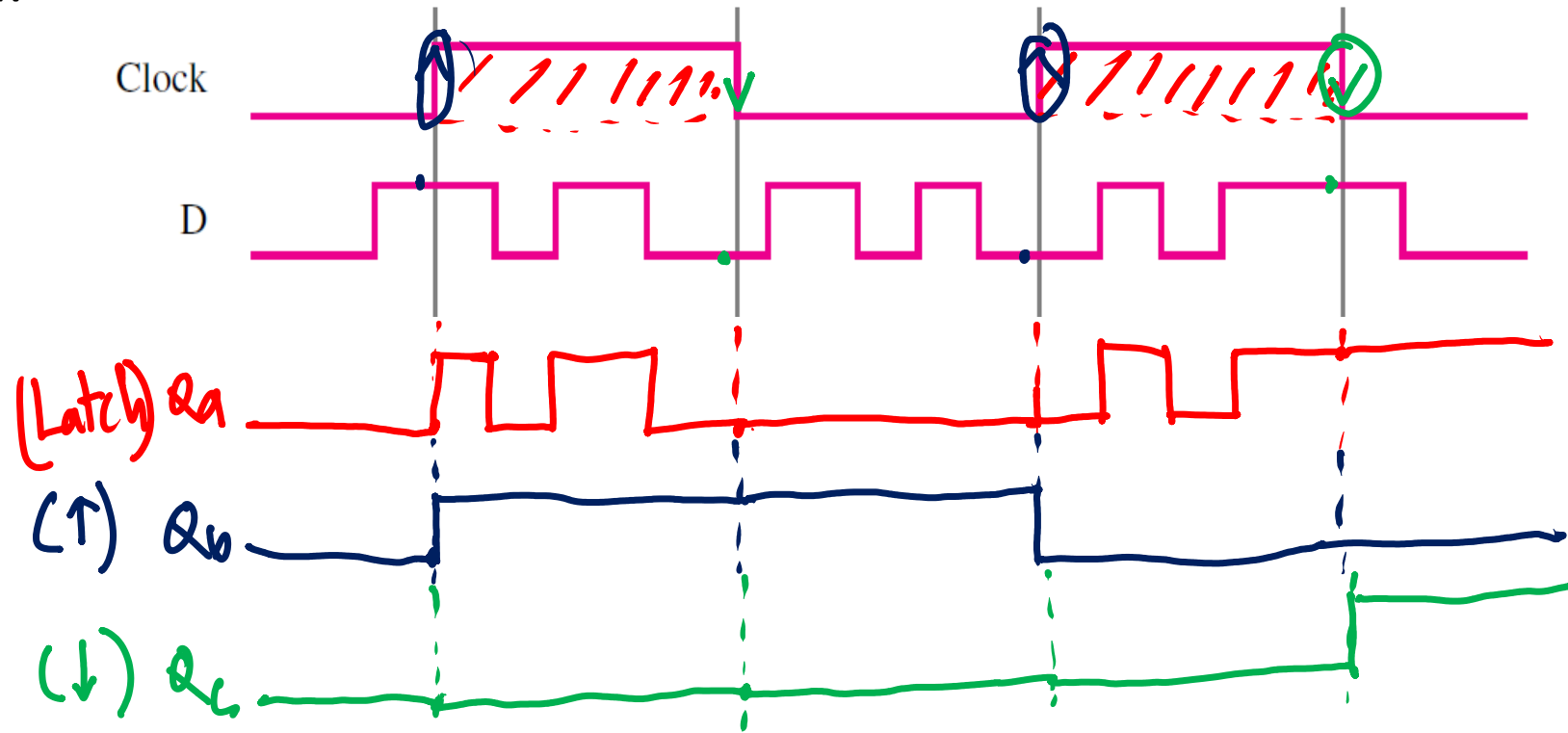
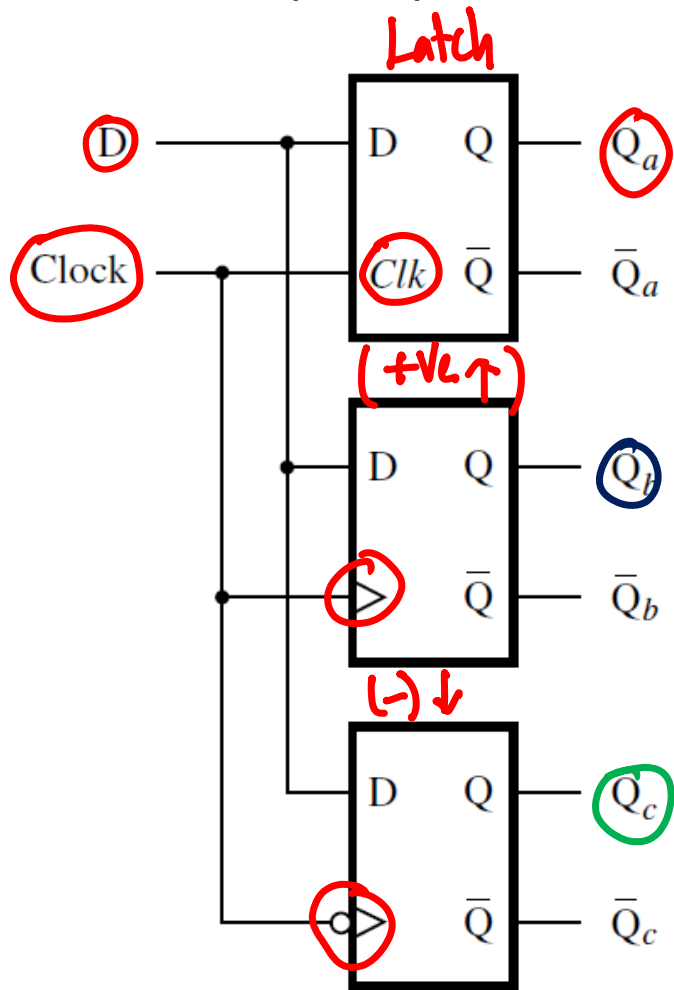


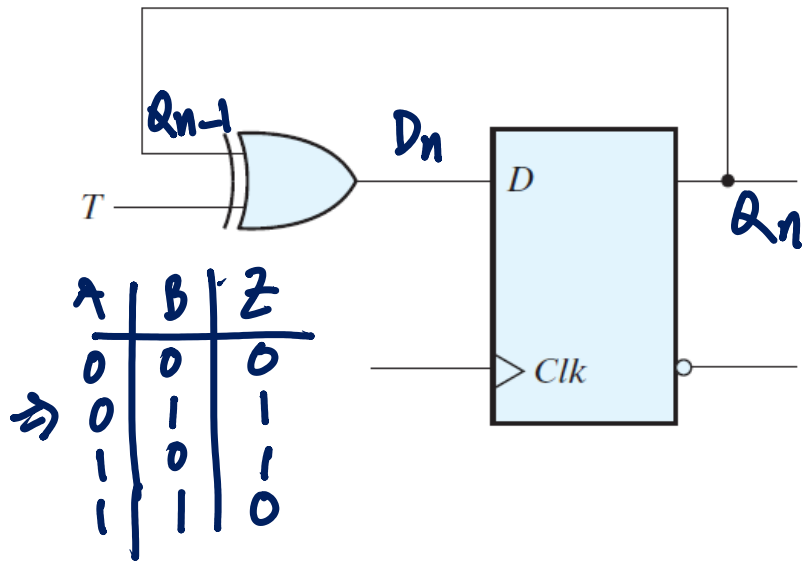
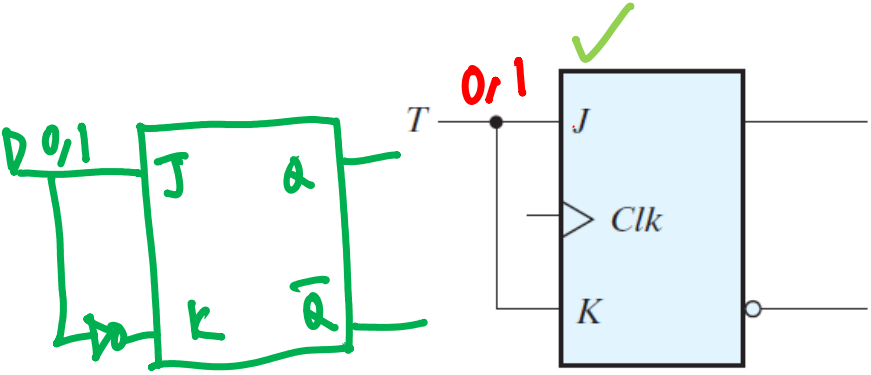
FLIP-FLOPS

- Clocked D Flip-flop and latch:



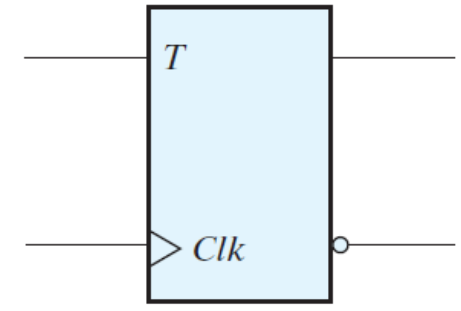
FLIP-FLOPS

- Clocked T Flip-flop:



T	Q _{n-1}	D _n	Q _n
→ 0	0	0	0
	1	1	1
→ 1	0	1	1
	1	0	0

$Q_n = Q_{n-1}$ for T=0
 $Q_n = \overline{Q_{n-1}}$ for T=1



JK Flip-Flop			
J	K	Q(t + 1)	
0	0	Q(t)	No change
0	1	0	Reset
1	0	1	Set
1	1	Q'(t)	Complement

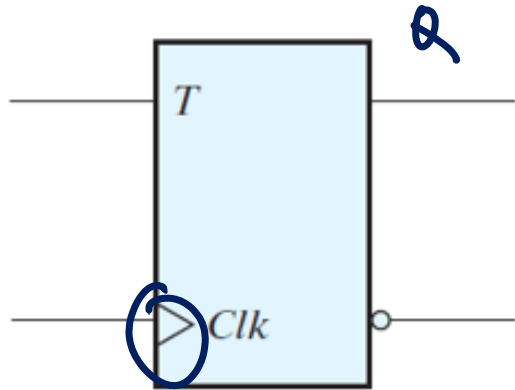
T=0 → 0, 0 → No change
 T=0 → 0, 1 → Reset
 T=0 → 1, 0 → Set
 T=1 → 1, 1 → Complement
 D FF (X D, FF)

D Flip-Flop		
D	Q(t + 1)	
0	0	Reset
1	1	Set

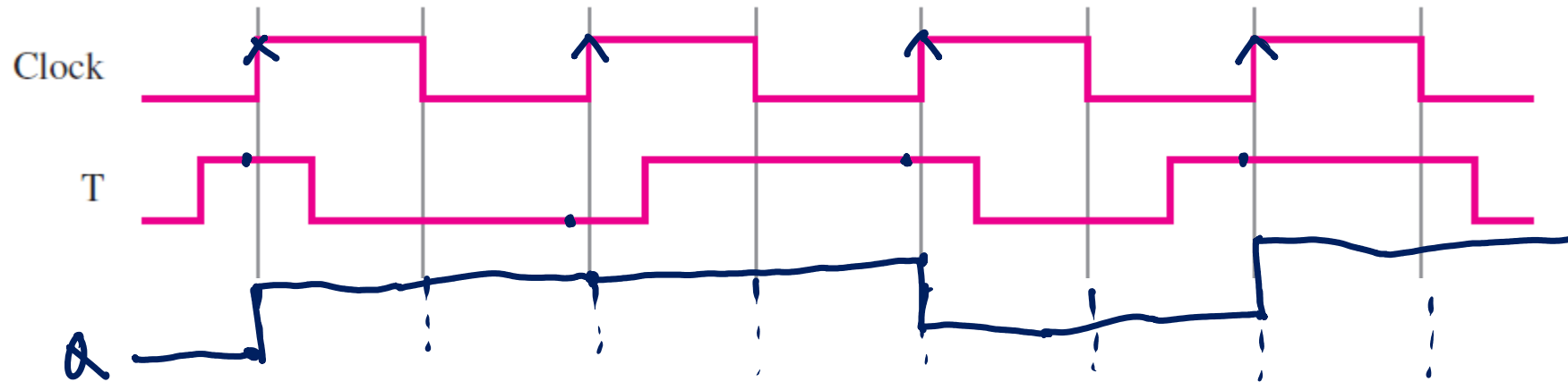
T Flip-Flop		
T	Q(t + 1)	
0	Q(t)	No change
1	Q'(t)	Complement

FLIP-FLOPS

- Clocked T Flip-flop:



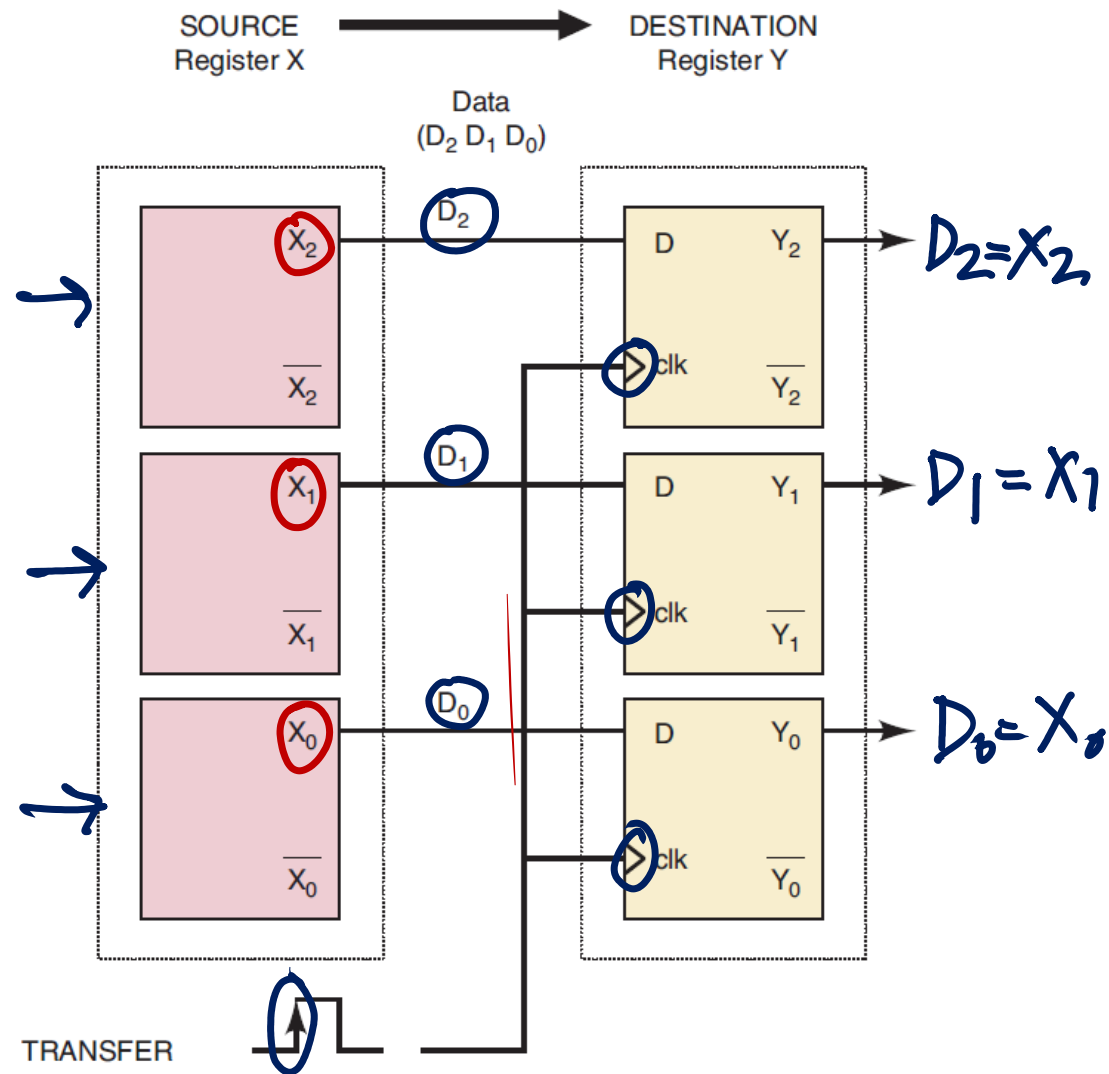
T Flip-Flop		
T	$Q(t + 1)$	
→ 0	$Q(t)$	No change
→ 1	$Q'(t)$	Complement



FLIP-FLOPS

- Parallel data transfer:

Number of transmission time = Number of data.

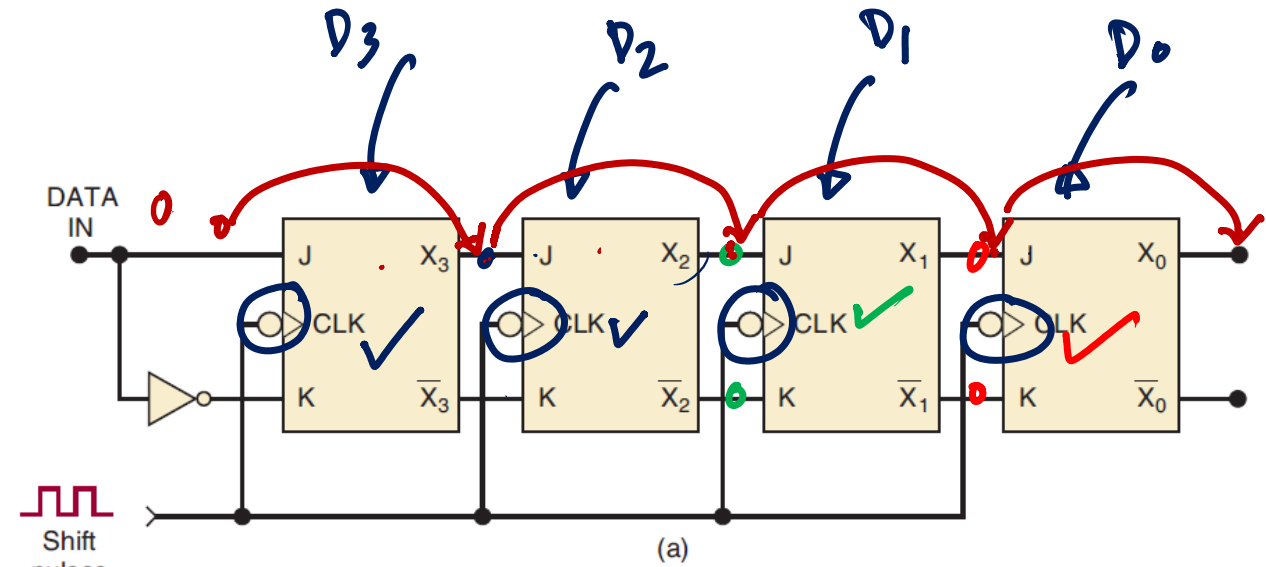
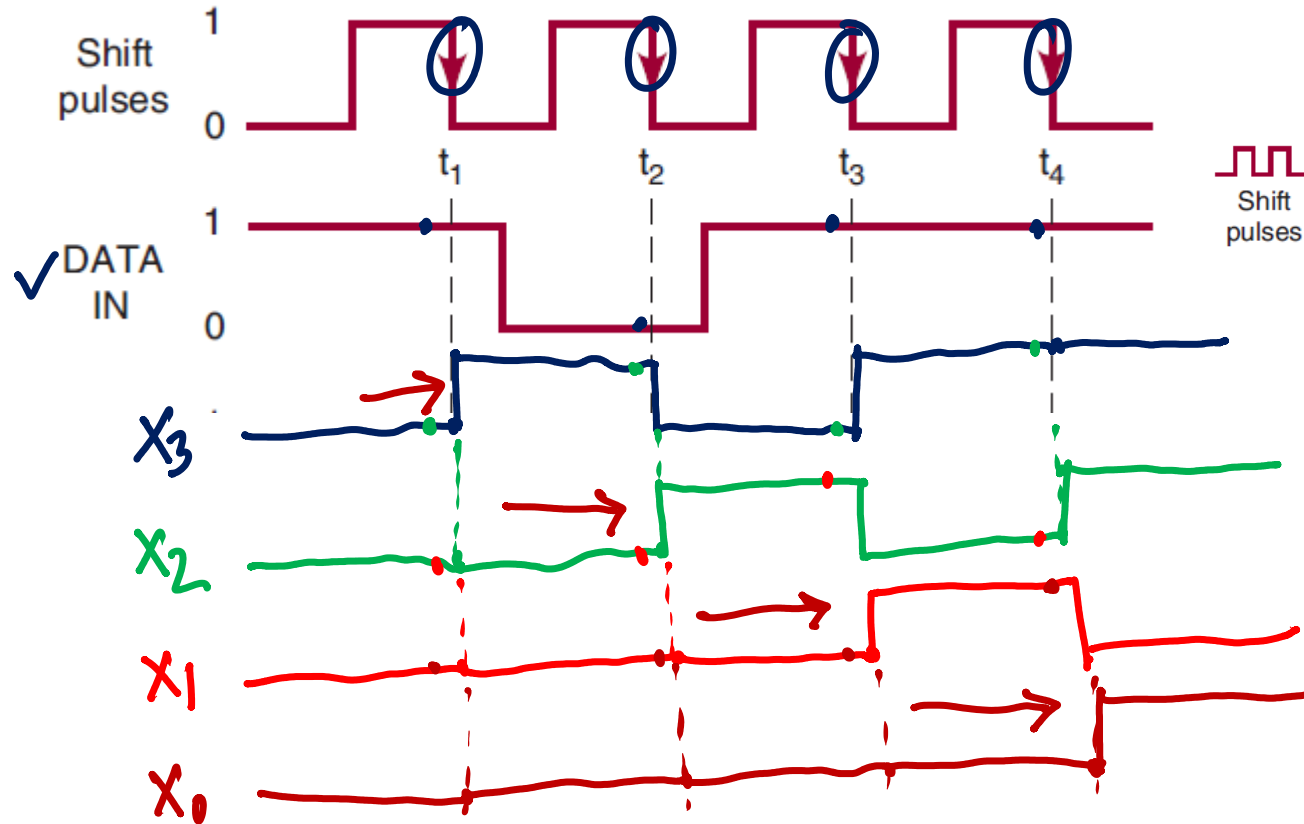


D	Edge	Q
0	↑	0
1	↑	1

(↑) $Q = D$

FLIP-FLOPS

- Serial data transfer (Shift register):



D	Q
0	0
1	1

