COUNTERS

SEQUENTIAL CIRCUITS

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TOPIC OUTLINE

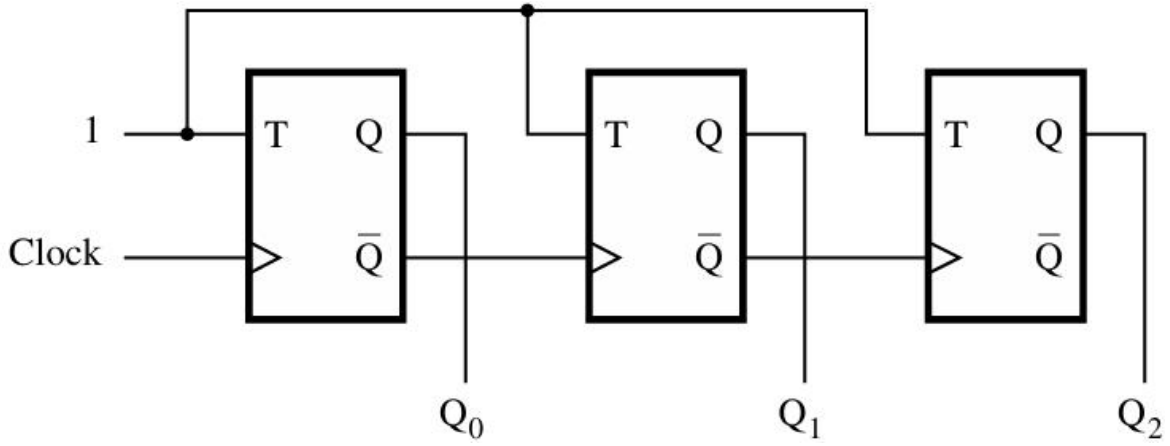
Asynchronous Counter

Synchronous Counter

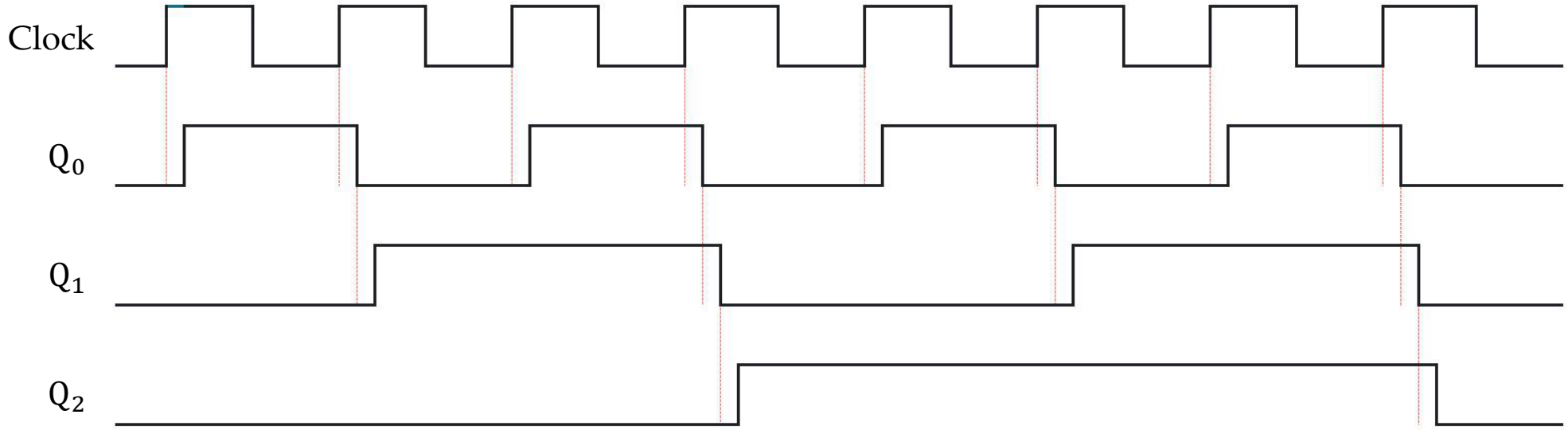
ASYNCHRONOUS COUNTERS

UP-COUNTER

A Three-Bit Up-Counter with T Flip-Flops

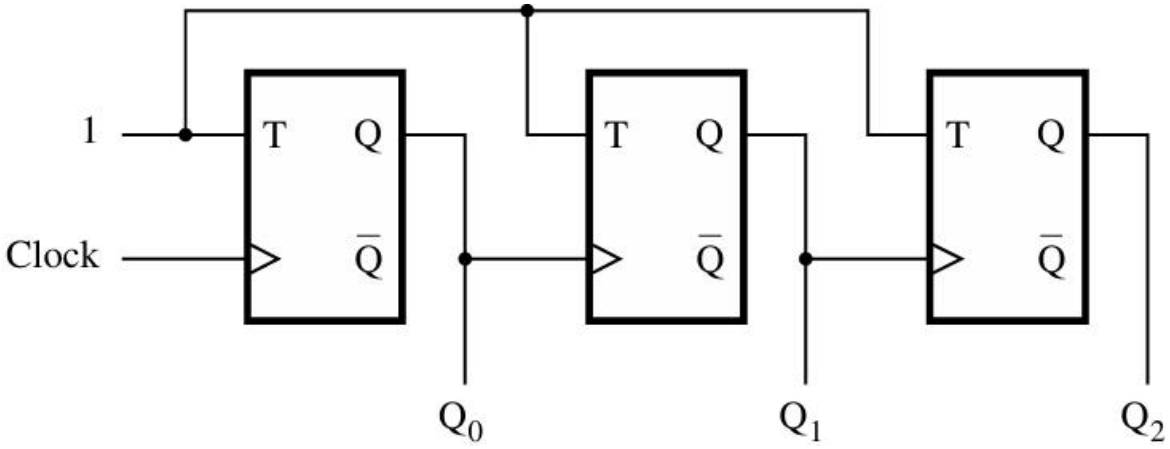


Timing Diagram

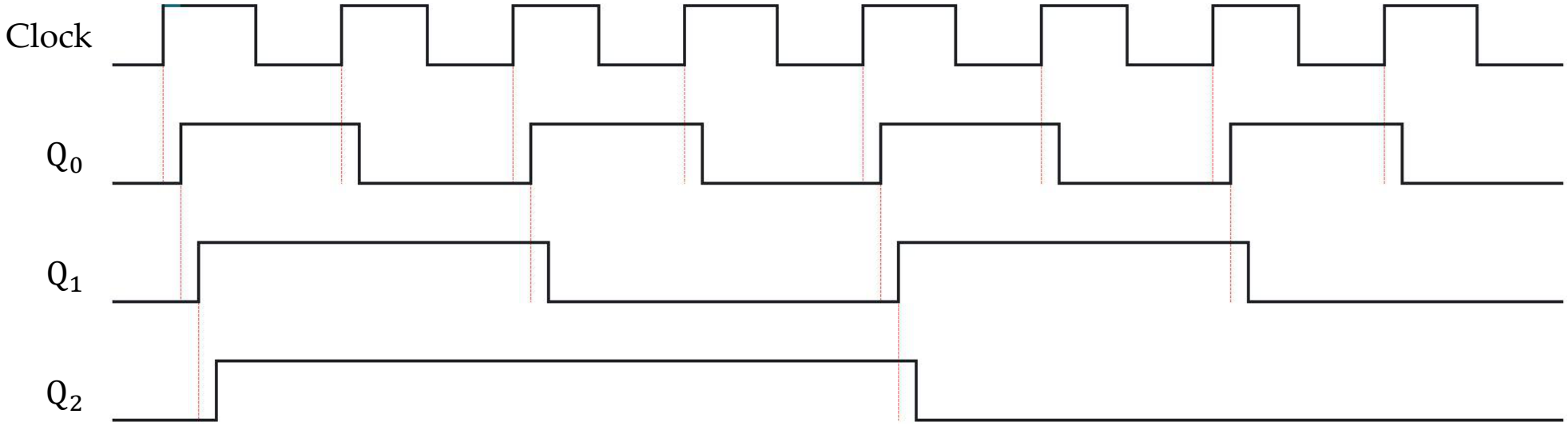


DOWN-COUNTER

A Three-Bit Down-Counter with T Flip-Flops



Timing Diagram



SYNCHRONOUS COUNTERS

SYNCHRONOUS COUNTERS

The previous counters are asynchronous – they are simple, but not very fast.

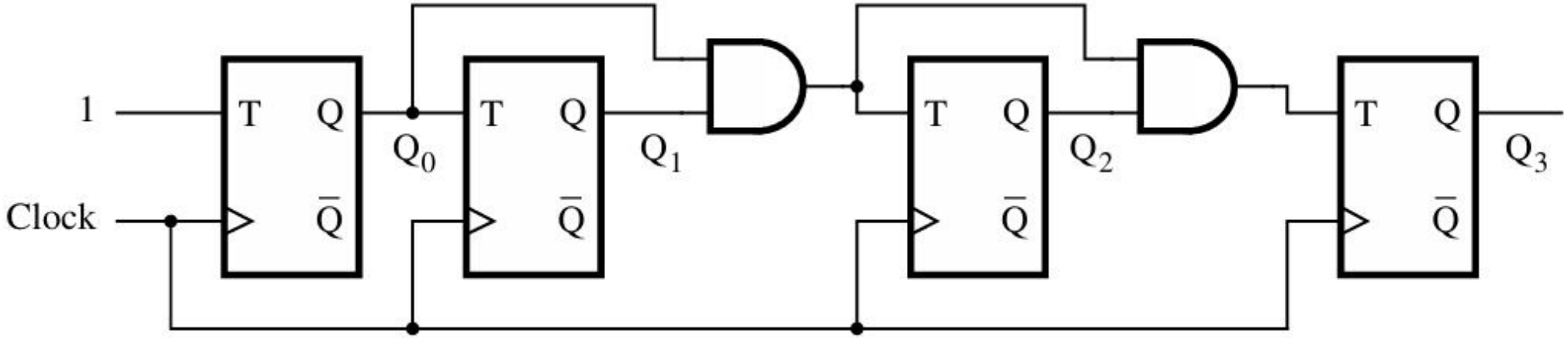
We can build a faster counter by clocking all flip-flops at the **same time**.

Derivation of the synchronous up-counter

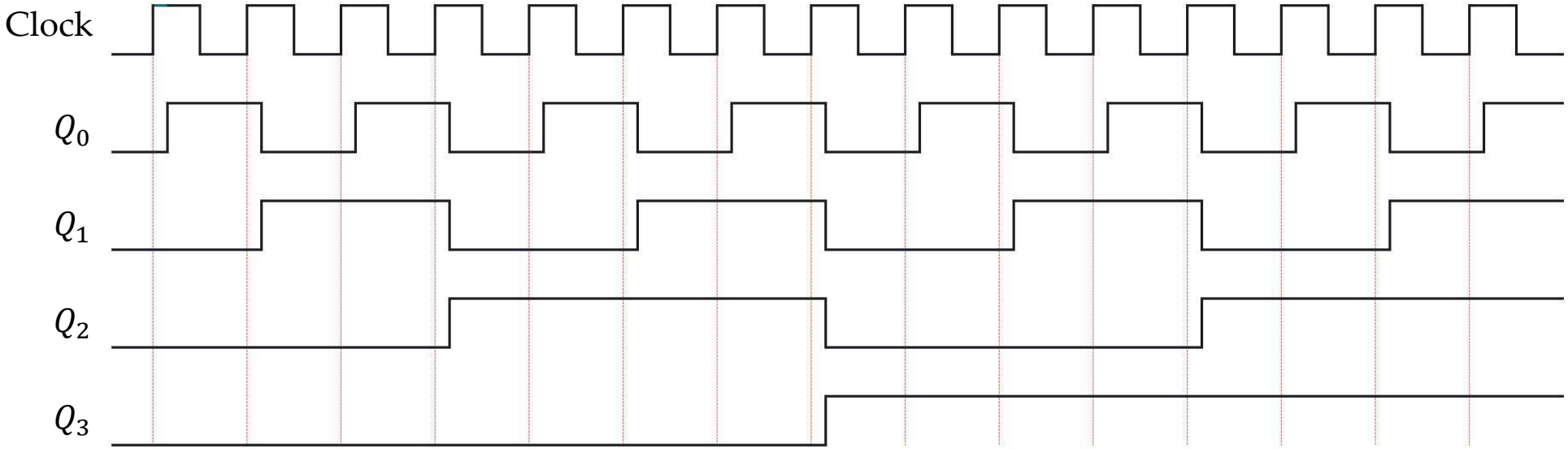
Clock cycle	Q_2 Q_1 Q_0
0	0 0 0
1	0 0 1
2	0 1 0
3	0 1 1
4	1 0 0
5	1 0 1
6	1 1 0
7	1 1 1
8	0 0 0

SYNCHRONOUS UP-COUNTER

A four-bit synchronous up-counter with T Flip-Flops

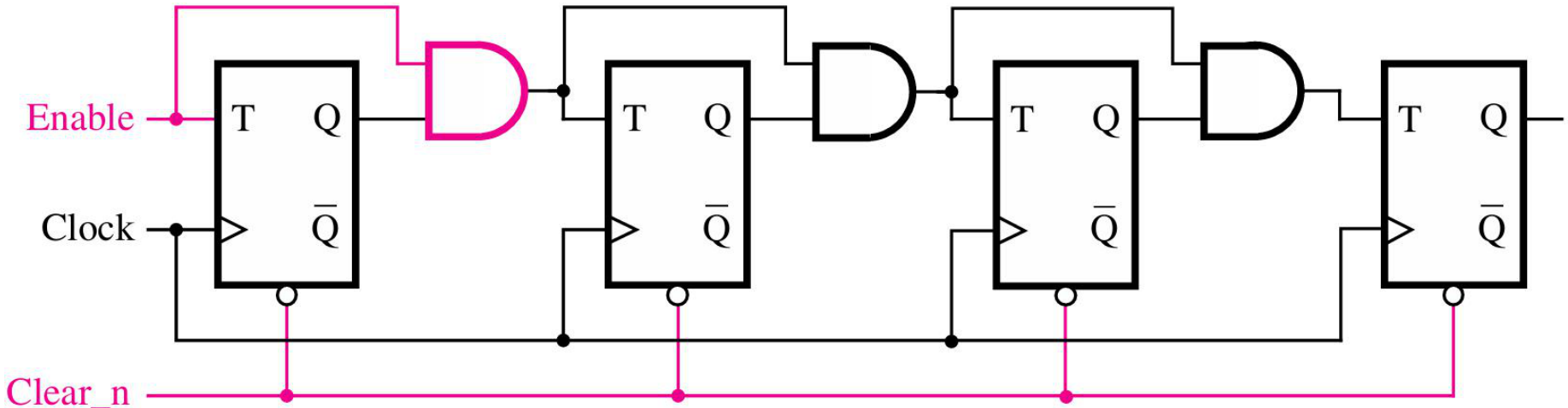


Timing Diagram



ENABLE AND CLEAR

Inclusion of Enable and Clear capability



LABORATORY