

EXPERIMENT – 9**DESIGN OF 4-BIT ASYNCHRONOUS COUNTER**

Aim: To design and realize the 4-bit asynchronous counter by using flip-flops.

Components Required:

S. No	Component Name	Quantity
1	IC 7474 (D – Flip flop)	4
2	Breadboard	1
3	Trainer kit	1
4	Connecting Wires	Required number

Pre-lab:**1. What is an asynchronous counter?**

Ans: Asynchronous counters are those counters which do not operate on simultaneous clocking. In asynchronous counter, only the first flip-flop is externally clocked using clock pulse while the clock input for the successive flip-flops will be the output from a previous flip-flop.

2. What is the difference between asynchronous up counter and down counter?

Ans: Up counter can count the clock pulses and gives the output in ascending order starting from “0000”. Whereas, the down counter can count the clock pulses and gives the output in descending order starting from “1111”.

3. How many clock pulses can be counted using 4-bit counter?

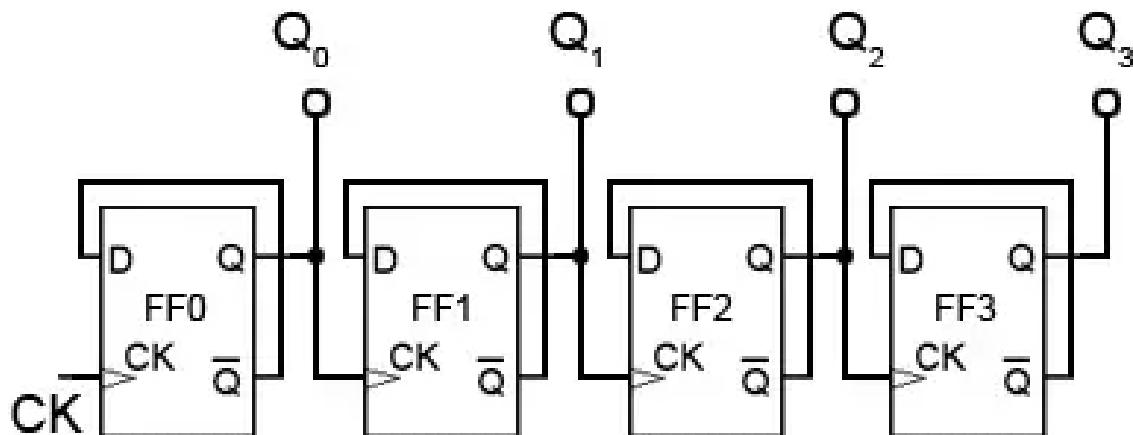
Ans: 16.

Theory:

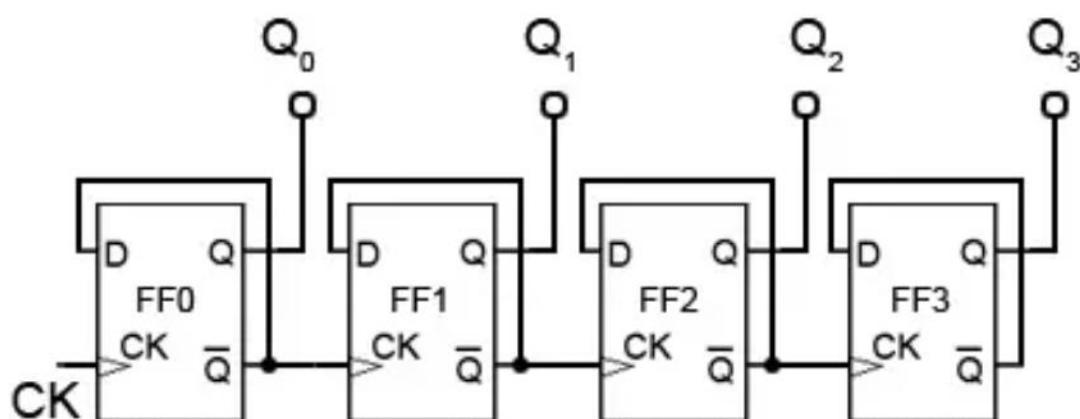
Asynchronous counters are those counters which do not operate on simultaneous clocking. In asynchronous counter, only the first flip-flop is externally clocked using clock pulse while the clock input for the successive flip-flops will be the output from a previous flip-flop. This means that only a single clock pulse is not driving all the flip-flops in the arrangement of the counter. Asynchronous counters are also known as ripple counters and are formed by the successive combination of trailing edge-triggered flip-flops. Asynchronous counters are slower than synchronous counters. However, asynchronous counters are used simply because they require less hardware and are cheaper to implement. The hardest step in designing asynchronous counters is identifying which flip-flops can be clocked from the outputs of other flip-flops.

Circuit Diagram:

4-Bit Down counter:



4-Bit Up counter:



Truth Table:

Clock Pulse	Decimal No.	Q₃	Q₂	Q₁	Q₀
1	0	0	0	0	0
2	1	0	0	0	1
3	2	0	0	1	0
4	3	0	0	1	1
5	4	0	1	0	0
6	5	0	1	0	1
7	6	0	1	1	0
8	7	0	1	1	1
9	8	1	0	0	0
10	9	1	0	0	1
11	10	1	0	1	0
12	11	1	0	1	1
13	12	1	1	0	0
14	13	1	1	0	1
15	14	1	1	1	0
16	15	1	1	1	1

Procedure:

1. Arrange the four D flip-flops as illustrated in the provided circuit diagram.
2. Apply the clock signal as shown in the figure.
3. Observe the output bits to get all possible combinations for four bits.

Viva Questions and answers:

1. Mention why Asynchronous counter is referred as Ripple Counter?
2. What is the purpose of Preset input?
3. What is the drawback of asynchronous counter?

4. How many flip-flops are required to design decade counter?

Result: The experiment successfully demonstrated the design and operation of 4-bit asynchronous counter using D flip-flops.