2− Shift Register.

- Shift registers are very important in application involving the storage transfer of data in digital system.
- The basic difference between a register and counter is that, register has no specified sequence of states except in certain very specialised applications.
- A register is used for storing and shifting data (1's and 0's) entered into it from an external source.
- The storage capability of a register makes it an important type of memory device.

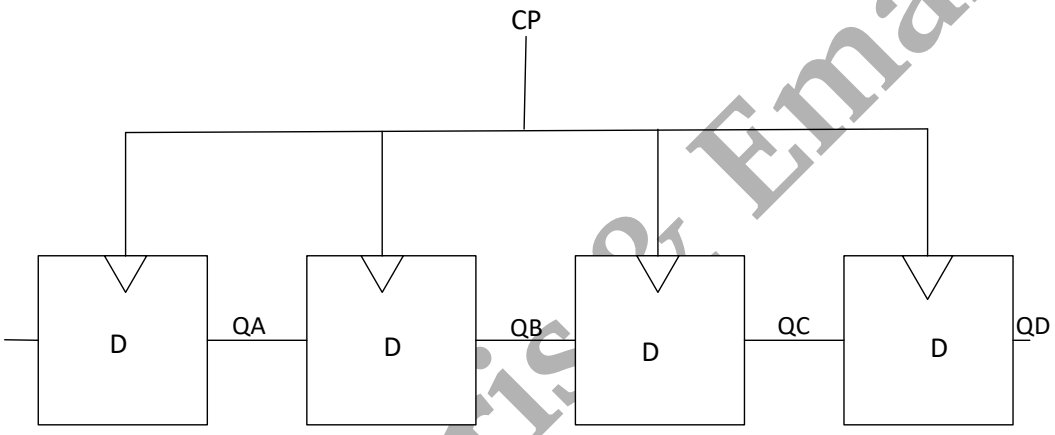
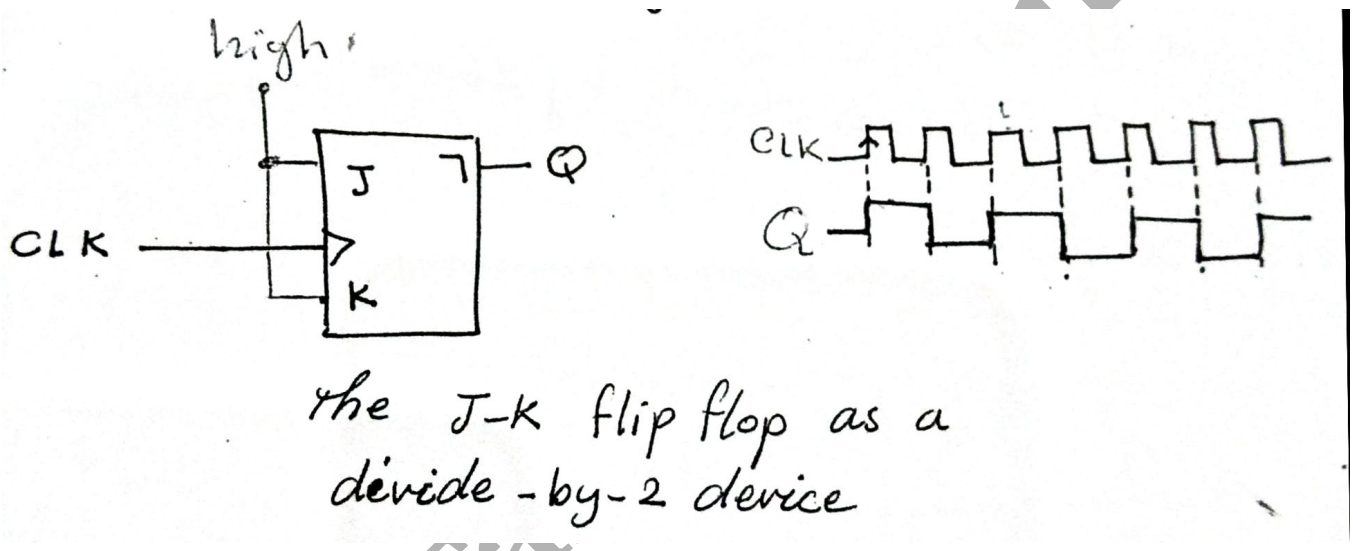


Figure 8: serial in serial out register

3– Frequency Division. Another basic application of ff is dividing (reducing) the frequency of a periodic waveform. When a pulse waveform is applied to the clk i/p of a JK flip flop that is connected to toggle, the Q o/p is a sequence wave with one half the frequency of the clock.

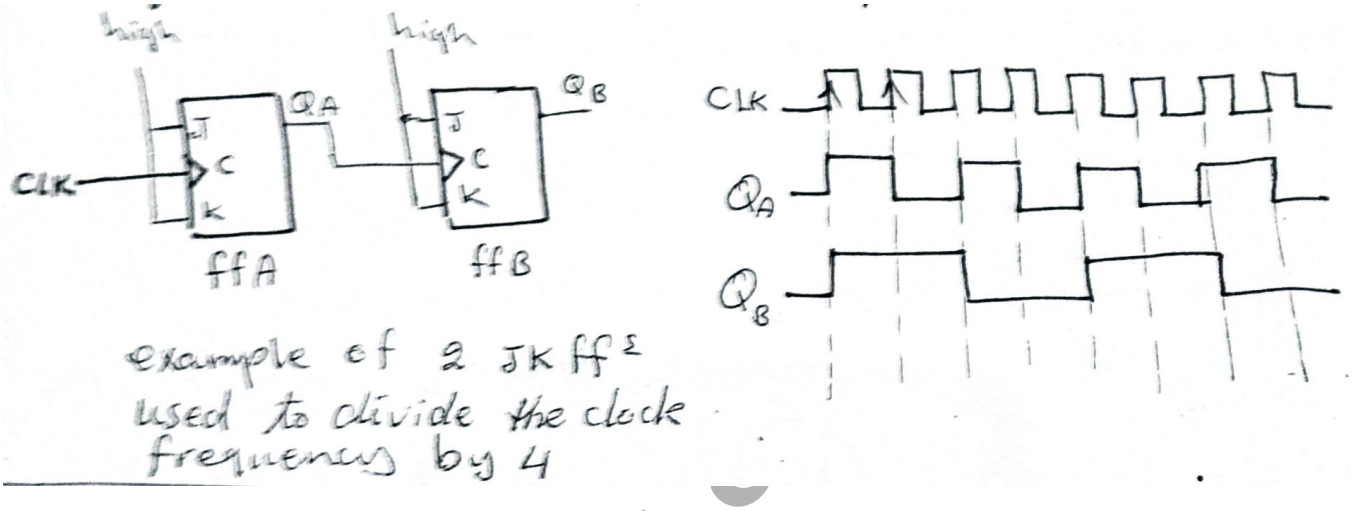
- A single ff is a divide by 2 device as shown below:



the J-K flip flop as a divide-by-2 device

Figure 9: The JK FF as a device divided by 2

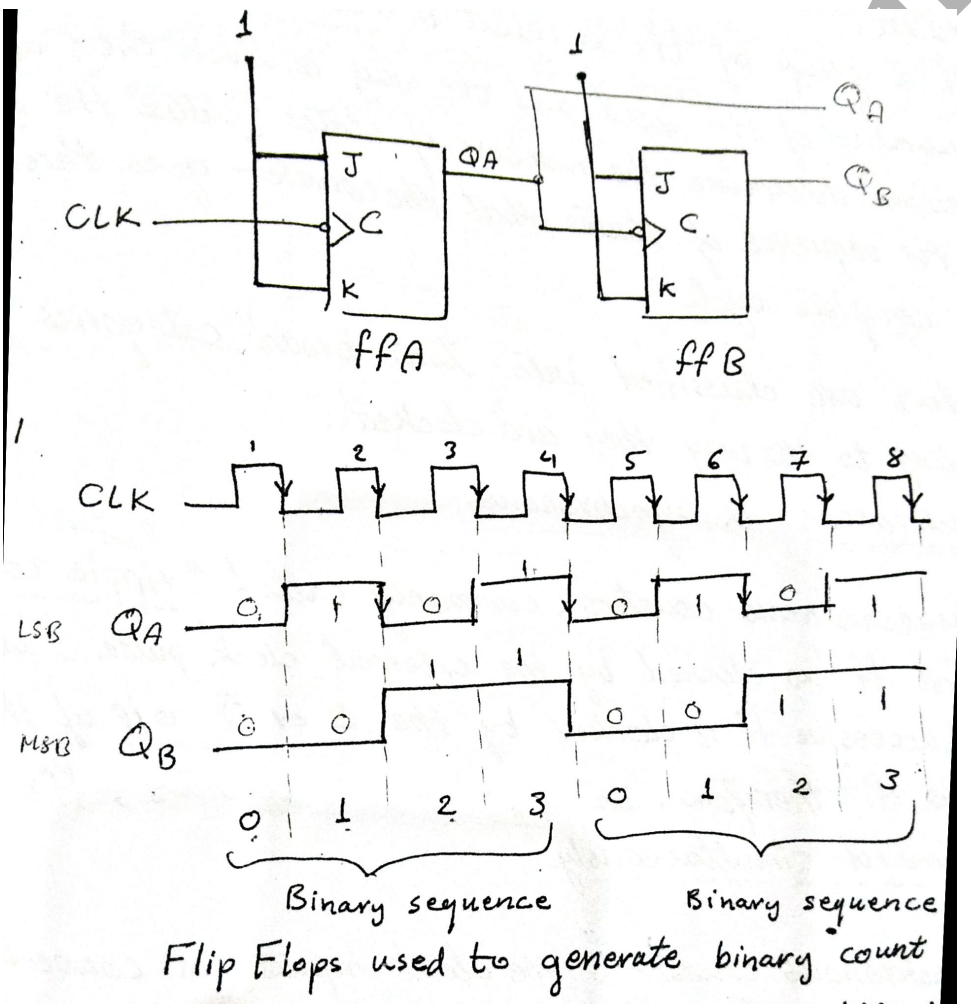
- Further Division of clock frequency can be achieved by using the o/p of one ff as a clock input to a second ff.



4– Counting. Another very important application of ff is in the digital counters.

- Flip flops are -ve Triggered JKs, Both ffs initially. (Reset)
- ff a toggles on -ve going transition of each clock pulse.
- The Qa o/p clocks ffB so that each time Qa make a high to low transition, ffB toggles.
- Binary sequence repeats every 4 clock pulses.
- The ffs are counting in sequence from 0 to 3 (00, 01, 10, 11) and then recycling back to 0 to begin the sequence again.

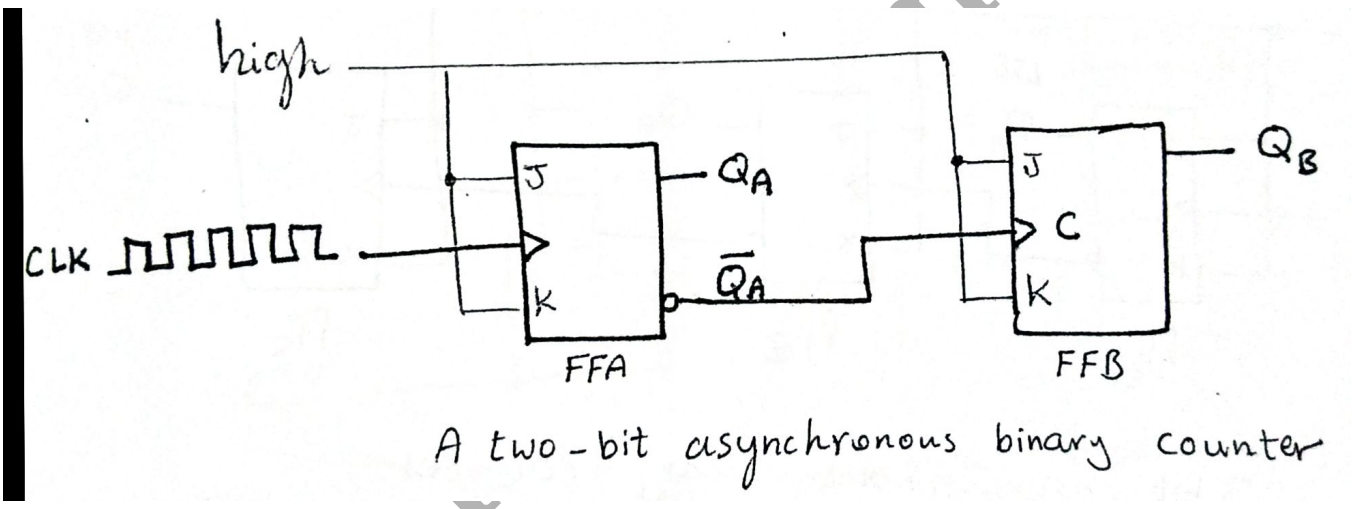
- Counters are classified into two broad categories according to the way they are clocked: asynchronous and synchronous.
- In asynchronous counters, commonly called ripple counters. The first ff is clocked by the external clock pulse, and then each successive ff is clocked by the Q or $\overline{Q}$ o/p of the previous ff. Therefore in asynchronous counters, ffs are not clocked simultaneously.



Flip Flops used to generate binary count

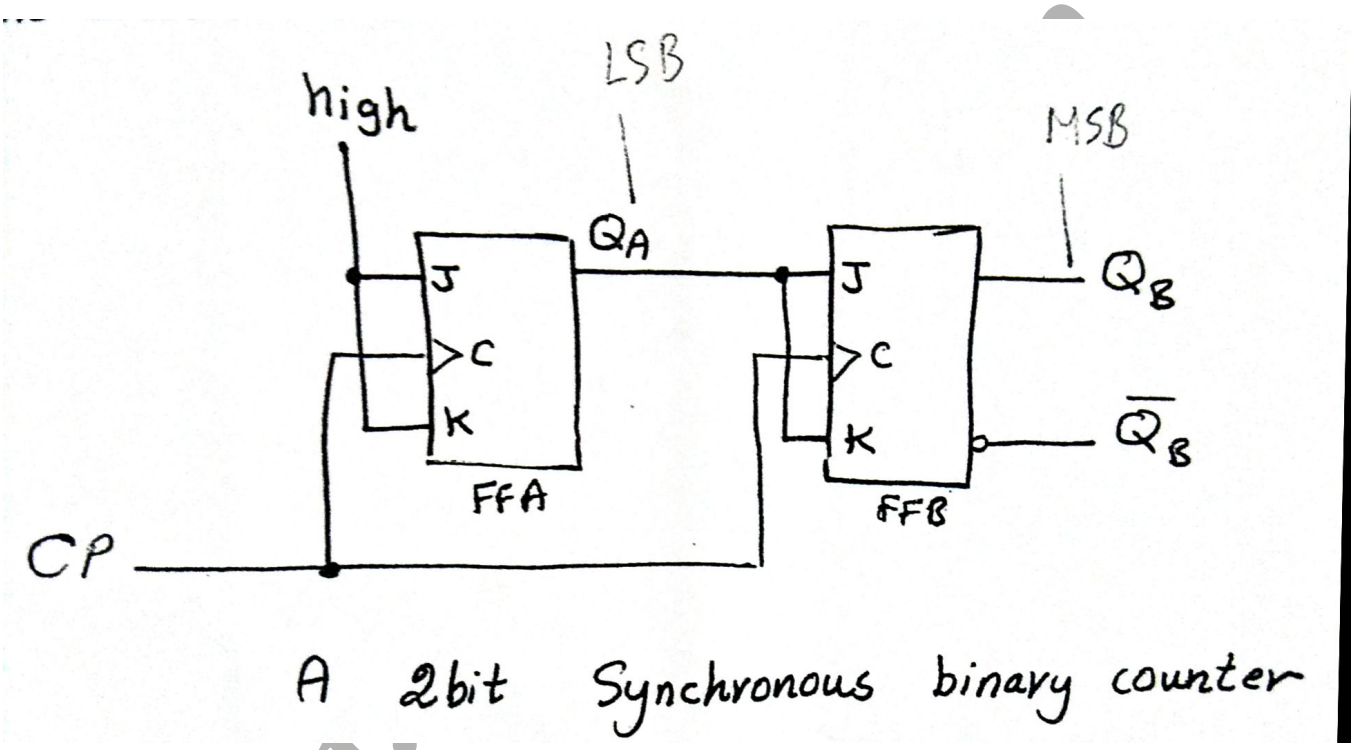
- In synchronous counters, the clock inputs is connected to all of the flip flops, and thus they are clocked simultaneously.

- **Asynchronous Counters**
  The term "Asynchronous" refers to events that do not occur at the same time. With respect to counter operation, asynchronous means that flip flops within the counter are not made to change states are exactly the same time, because the clock pulses are not connected directly to the "C" i/p of each ff in the counter.



A two-bit asynchronous binary counter

- **synchronous Counters**
  The term "Synchronous" means that the counter is clocked successive that each ff in the counter is triggered at the same time. This is accomplished by connecting the clock line to each stage of the counter.



A 2bit Synchronous binary counter