Assam Textile Institute

Empowering Textile Education

CLASS = 03

☑ Theory

☐ Practical

COURSE TITLE = TEXTRONICS

COURSE CODE= TT-603

by,

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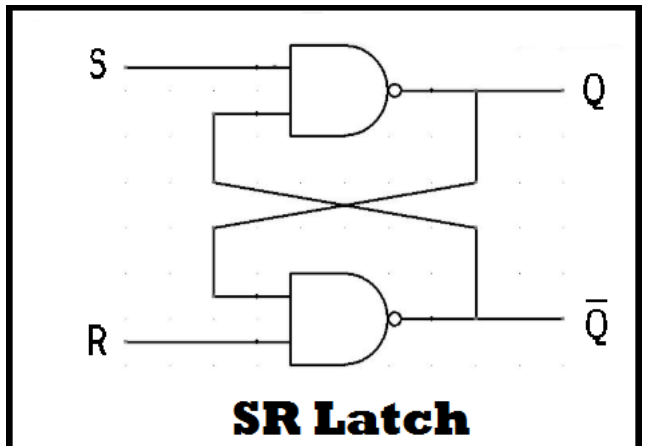
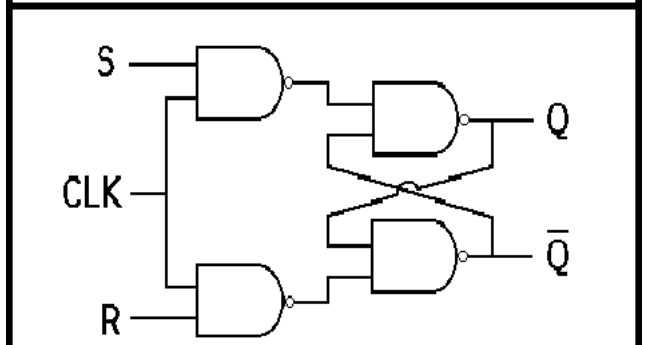
: Latch, Flip Flop and It's Types :

- A ***flip flop*** is an electronic circuit with two stable states that can be used to store binary data. The stored data can be changed by applying varying inputs.
- ***Flip-flops and Latches*** are fundamental building blocks of digital electronics systems used in computers, communications and many other types of systems.
- Flip-flops and latches are used as data storage elements. It is the basic storage element in ***sequential*** logic.
- Both **Latches and flip flops** are circuit elements where the output not only depends on the current inputs, but also depends on the previous input and outputs.
- The main *difference* between the latch and flip flop is that a flip flop has a ***clock signal***, whereas a latch does not have clock signals.



SR Latch

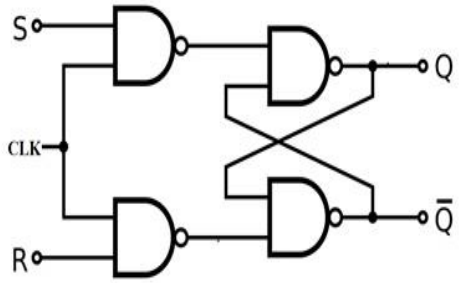


SR Flip Flop

:Types of Flip Flop and Truth Tables:

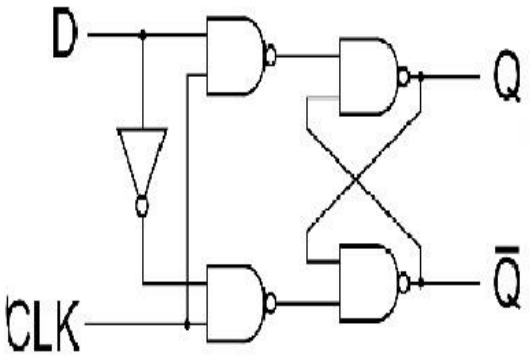
- Flip-flops can be divided into common types: the **SR** ("set-reset"), **D** ("data" or "delay"), **T** ("toggle"), and **JK**.
- The behavior of a particular type can be described by what is termed the characteristic equation, which derives the "next" (i.e., after the next clock pulse) output, Q_{next} in terms of the input signal(s) and/or the current output.

SR Flip Fliop



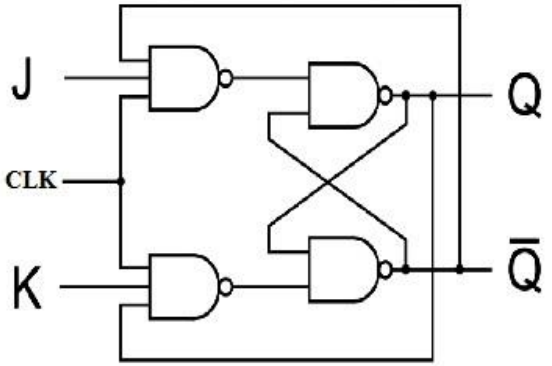
S	R	Q_{next}	Action
0	0	Q	Hold state
0	1	0	Reset
1	0	1	Set
1	1	X	Not allowed

D Flip Flop



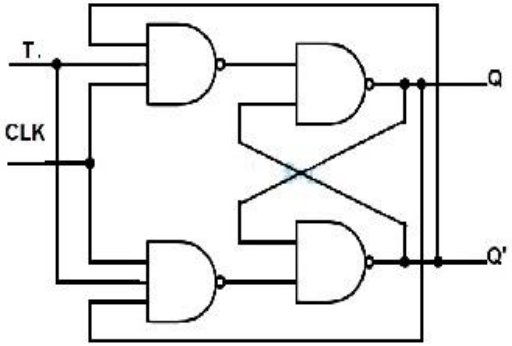
D	Q(Next)
0	0
1	1

JK Flip Fliop



J	K	Q_{next}	Comment
0	0	Q	No change
0	1	0	Reset
1	0	1	Set
1	1	$\overline{Q}$	Toggle

T Flip Flop



T	Q(Next)
0	Q
1	$\overline{Q}$

:Types of Flip Flop and Truth Tables:

S	R	Q_{next}	Action
0	0	Q	Hold state
0	1	0	Reset
1	0	1	Set
1	1	X	Not allowed

S	R	Q	Q(Next)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	x
1	1	1	x

D	Q(Next)
0	0
1	1

D	Q	Q(Next)
0	0	0
0	1	0
1	0	1
1	1	1

T	Q(Next)
0	Q
1	$\overline{Q}$

T	Q	Q(Next)
0	0	0
0	1	1
1	0	1
1	1	0

J	K	Q_{next}	Comment
0	0	Q	No change
0	1	0	Reset
1	0	1	Set
1	1	$\overline{Q}$	Toggle

J	K	Q	Q(Next)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

: Counters in Digital Logic :

- In digital logic and computing, a ***Counter*** is a device which stores (and sometimes displays) the number of times a particular event or process has occurred, often in relationship to a clock signal.
- Counters are used in digital electronics for counting purpose, they can count specific event happening in the circuit.
- In ***UP Counter*** a counter increases count for every rising edge of clock and
- In ***DOWN Counter*** a counter decreases count for every rising edge of clock.

Counter Classification

Counters are broadly divided into two categories—

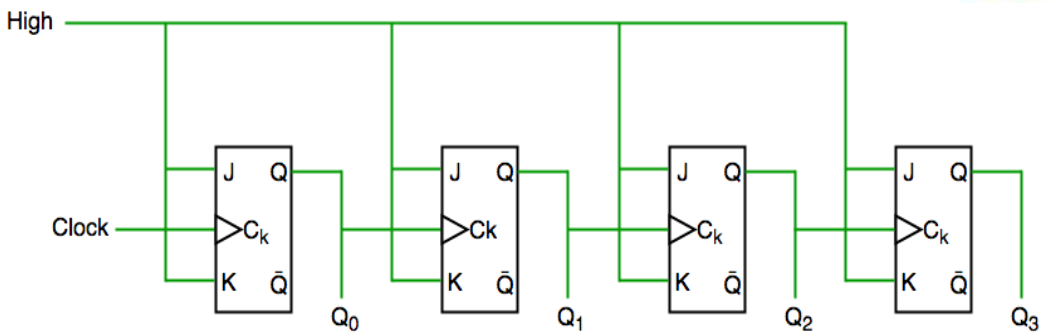
1) Asynchronous counter and
2) Synchronous counter

: Counters in Digital Logic :

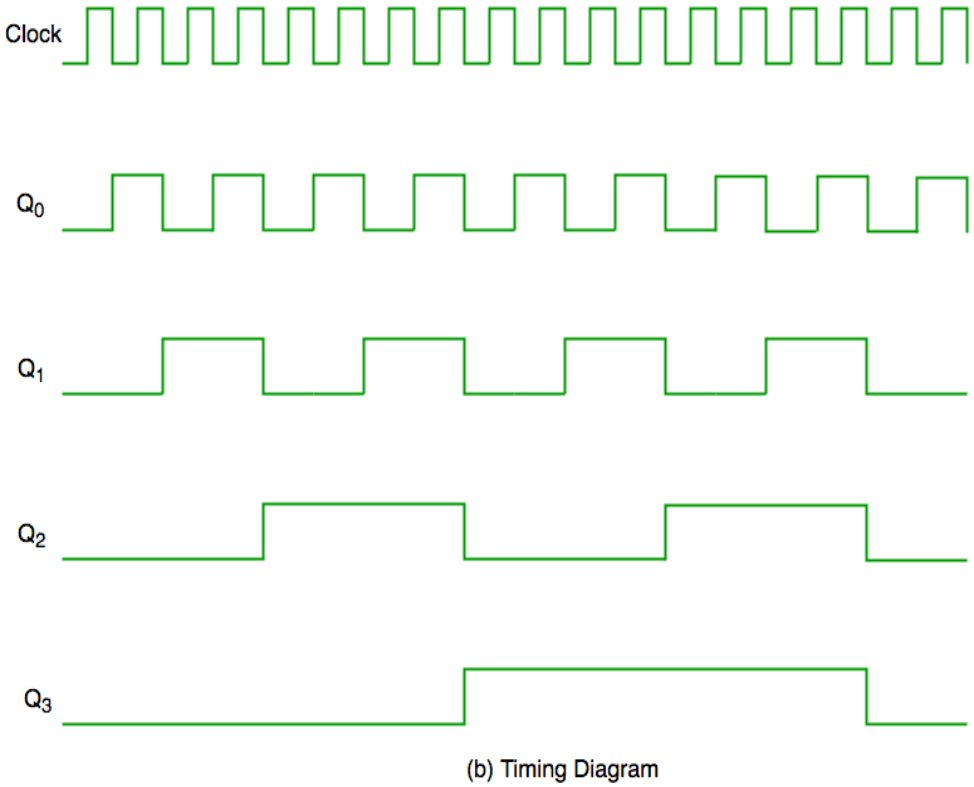
1. Asynchronous Counter

In asynchronous counter we don't use universal clock, only first flip flop is driven by main clock and the clock input of rest of the following counters is driven by output of previous flip flops.

It is shown in timing diagram that Q0 is changing as soon as the rising edge of clock pulse is encountered, Q1 is changing when rising edge of Q0 is encountered(because Q0 is like clock pulse for second flip flop) and so on. In this way ripples are generated through Q0,Q1,Q2,Q3 hence it is also called **RIPPLE counter.**



(a) Asynchronous counter



(b) Timing Diagram

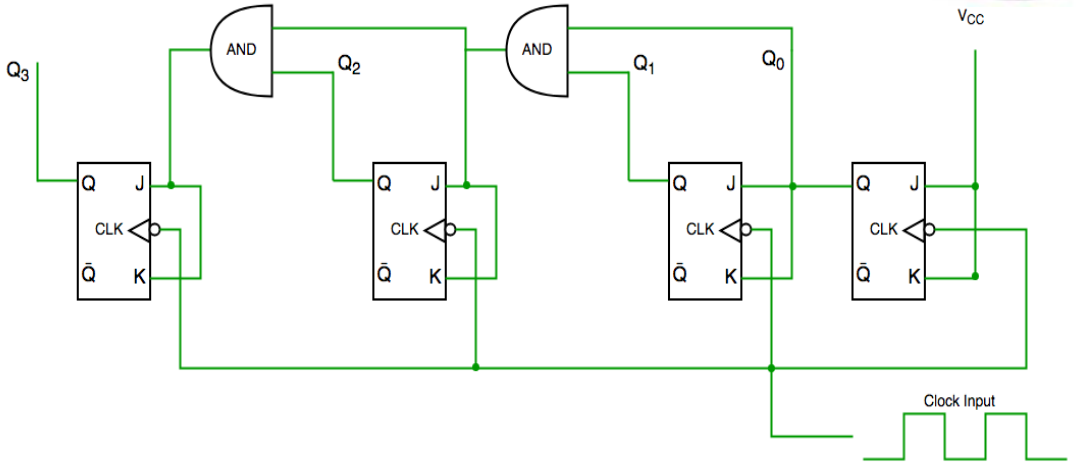
: Counters in Digital Logic :

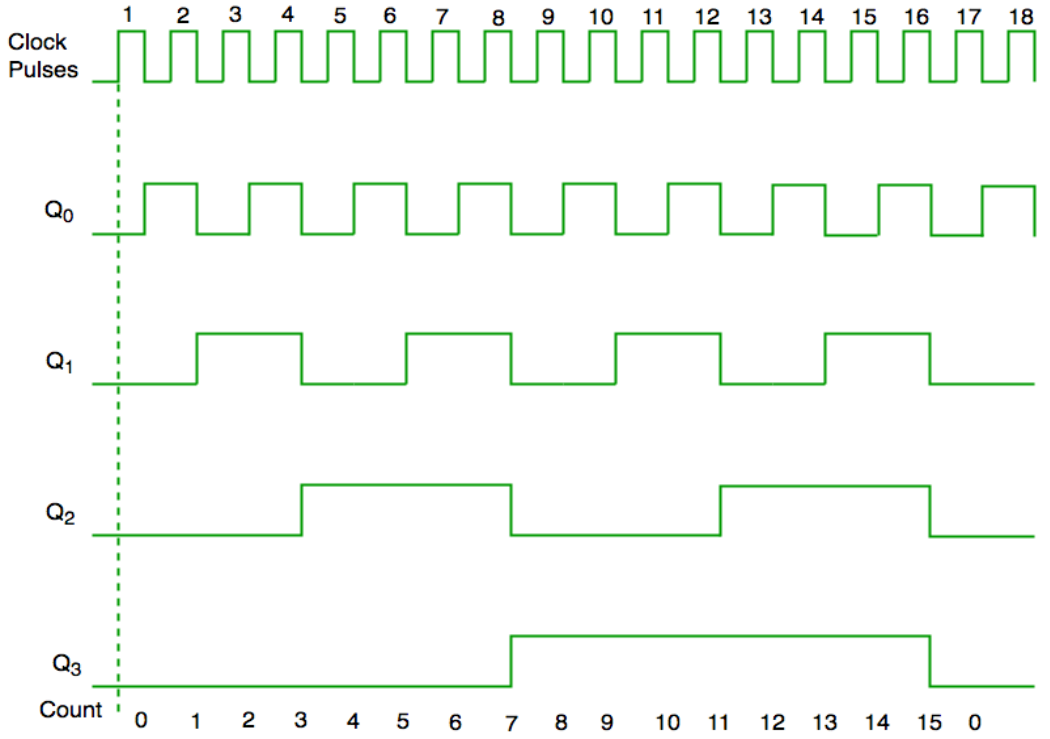
2. **Synchronous Counter**

Unlike the asynchronous counter, synchronous counter has one global clock which drives each flip flop so output changes in parallel.

The one *advantage* of synchronous counter over asynchronous counter is, it can operate on higher frequency than asynchronous counter as it does not have cumulative delay because of same clock is given to each flip flop.

It is shown in timing diagram that that Q0 bit gives response to each falling edge of clock while Q1 is dependent on Q0, Q2 is dependent on Q1 and Q0 , Q3 is dependent on Q2,Q1 and Q0.





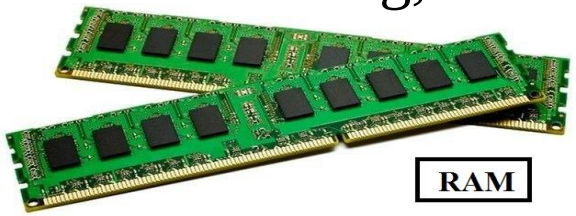
: RAM and ROM :

- **Random Access Memory (RAM) :**

➢ RAM is a form of data storage. It is a hardware in computing device where the operating system , applications & data in current use are kept so they can be quickly reached by the device's Processor .

➢ RAM is much faster to read and write in comparison to other kinds of storage in a computer, such as a hard disk drive (H.D.D) etc.

➢ Data remains in RAM as long as the computer is running, When the computer is turned off, RAM loses its data.



- **Read Only Memory (ROM) :**

➢ The instructions in ROM prepare the computer for use.

➢ These instructions can only be read and cannot be changed or deleted.

➢ Writing new information or instruction into the ROM is not possible.

➢ ROM stores data and instructions permanently. When the power is switched off, the instructions stored in ROM are not lost.

: Differences between RAM and ROM :

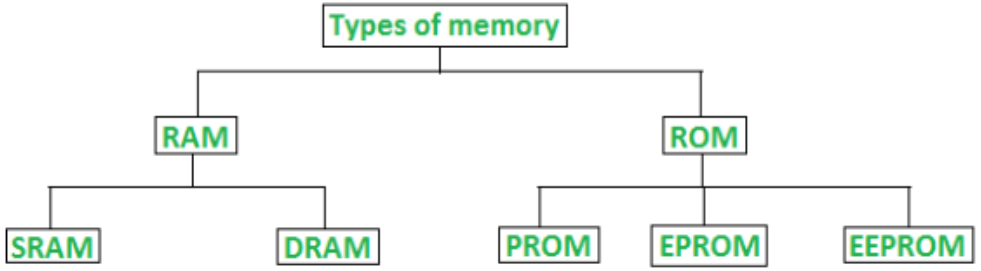
RAM

- Volatile*(maintains its data while the device is powered).*
- Stores information temporary.
- Requires flow of electricity to retain data.
- Large size with higher capacity
- Used for both read and write
- Very fast but uses a lot of power
- Used in CPU cache, primary memory
- Costlier

ROM

- Non-Volatile *(does not lose content when power is lost).*
- Stores information permanently.
- Does not require flow of electricity to retain data.
- Small size with less capacity
- Used only for reading
- Fast but uses very little power
- Used in firmware, microcontrollers.
- Cheaper than RAM

: Types of RAM and ROM :



DRAM (Dynamic RAM)	SRAM (Static RAM)
1. Constructed of tiny capacitors that leak electricity.	1.Constructed of circuits similar to D flip-flops.
2.Requires a recharge every few milliseconds to maintain its data.	2.Holds its contents as long as power is available.
3.Inexpensive.	3.Expensive.
4. Slower than SRAM.	4. Faster than DRAM.
5. Can store many bits per chip.	5. Can not store many bits per chip.
6. Uses less power.	6.Uses more power.
7.Generates less heat.	7.Generates more heat.
8. Used for main memory.	8. Used for cache.

Types of Read Only Memory (ROM)

1. ***PROM*** *(Programmable read-only memory)* – It can be programmed by user. Once programmed, the data and instructions in it cannot be changed.

1. ***EPROM*** *(Erasable Programmable read only memory)* – It can be reprogrammed. To erase data from it, expose it to ultra violet light. To reprogram it, erase all the previous data.

2. ***EEPROM*** *(Electrically erasable programmable read only memory)* – The data can be erased by applying electric field, no need of ultra violet light. We can erase only portions of the chip.