Experiment No. 4
FLIP-FLOP IC
Name: Priyanka Narendra Bhandari
Roll Number: 17
Date of Performance:
Date of Submission:

FLIP-FLOP IC

AIM:- To study about Flip-Flop IC's.

Objective :- To construct and study the Types of Flip Flop ICs:

SR Flip-Flop - (Set-Reset)

D-type Flip-Flop - (Data)

T Flip-Flop - (Toggle)

JK Flip-Flop

Theory :-The term flip-flop has historically referred generically to both level-triggered (asynchronous, transparent, or opaque) and edge-triggered (synchronous, or clocked) circuits that store a single bit of data using gates. Flip-flops and latches are used as data storage elements to store a single bit (binary digit) of data; one of its two states represents a "one" and the other represents a "zero".

Flip-flops are widely used in digital circuits and have many applications, including:

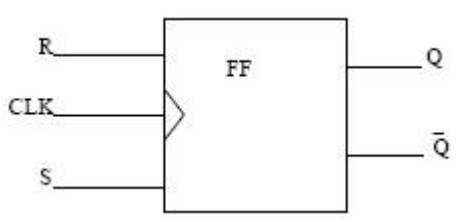
>> Memory elements
>> Counters
>> Shift registers
>> Frequency dividers.
>> Synchronizers.
>> State machines.
>> Data storage.

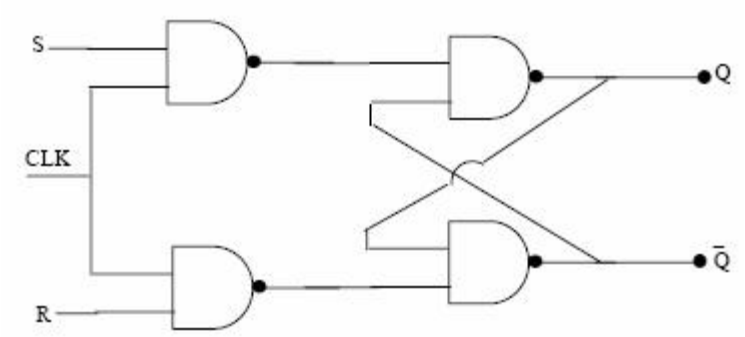
The fundamental latch is the simple SR flip-flop, where S and R stand for set and reset respectively. It can be constructed from a pair of cross-coupled NOR logic gates. The stored bit is present on the output marked Q.

Normally, in storage mode, the S and R inputs are both low, and feedback maintains the outputs in a constant state, with Q and the complement of Q. If S (Set) is given with high while R is held low, then the Q output is forced high, and stays high even after S returns

low; similarly, if R (Reset) is given with high while S is held low, then the Q output is forced low, and stays low even after R returns low.

SR Circuit Daigram.





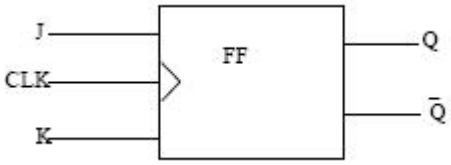
SR Truth Table.

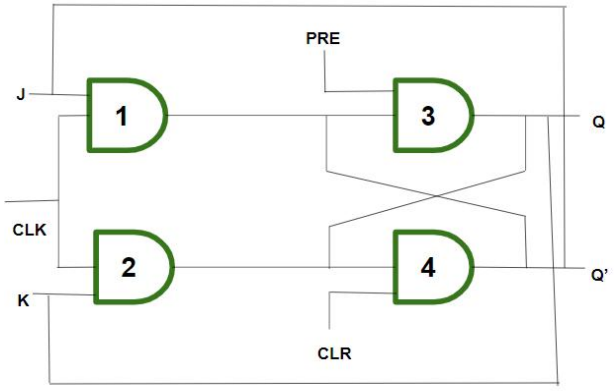
CP	S	R	Q	Q_{+1}	State
1	0	0	0	0	No change
1	0	0	1	1	
1	0	1	0	0	RESET
1	0	1	1	0	
1	1	0	0	1	SET
1	1	0	1	1	
1	1	1	0	x	Indeterminate
1	1	1	1	x	
0	x	x	0	0	No Change
0	x	x	1	1	

2) JK Flip-Flop

The JK flip-flop augments the behavior of the SR flip-flop (J = Set, K = Reset) by interpreting the S = R = 1 condition as a "flip" or toggle command. Specifically, the combination J = 1, K = 0 is a command to set the flip-flop; the combination J = 0, K = 1 is a command to reset the flip-flop; and the combination J = K = 1 is a command to toggle the flip-flop, i.e., change its output to the logical complement of its current value.

JK flip flop Circuit Daigram.





JK flip flop Truth Table.

Truth Table

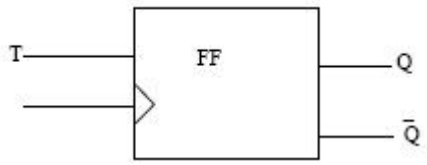
Trigger	Inputs		Output				Inference
			Present State		Next State		
CLK	J	K	Q	$\bar{Q}$	Q	$\bar{Q}$	
↑	x	x	-		-		Latched
↑	0	0	0	1	0	1	No Change
↑			1	0	1	0	
↑	0	1	0	1	0	1	Reset
↑			1	0	0	1	
↑	1	0	0	1	1	0	Set
↑			1	0	1	0	
↑	1	1	0	1	1	0	Toggles
↑			1	0	0	1	

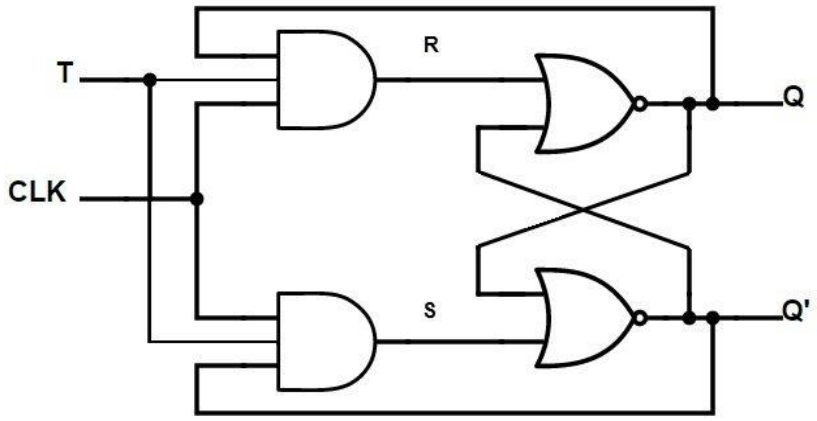
Table I Truth table for positive-edge triggered JK flip-flop

3) T Flip-Flop - (Toggle)

If the T input is high, the T flip-flop changes state ("toggles") whenever the clock input is strobed. If the T input is low, the flip-flop holds the previous value. This behavior is described by the characteristic equation: A T flip-flop can also be built using a JK flip-flop (J & K pins are connected together and act as T) or D flip-flop.

T flip flop Circuit Daigram.





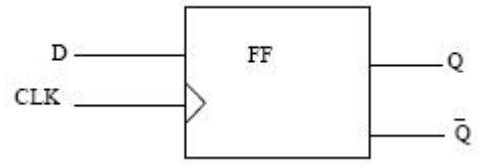
T flip flop Truth Table

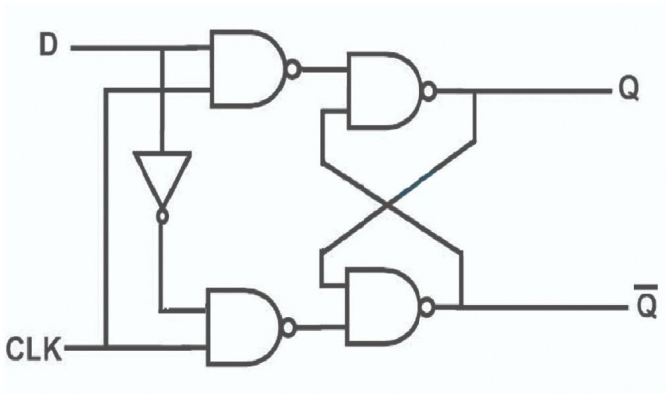
Input	Outputs	
	Present State	Next State
T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

4) D-type Flip-Flop - (Data)

The Q output always takes on the state of the D input at the moment of a rising clock edge. (or falling edge if the clock input is active low) It is called the D flip-flop for this reason, since the output takes the value of the D input or Data input, and Delays it by one clock count. The D flip-flop can be interpreted as a primitive memory cell, zero-order hold, or delay line.

T flip flop Circuit Daigram





D flip flop Truth Table

Input			Output	
D	reset	clock	Q	Q'
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	0	1

Conclusion.

Flip-flops can be generalized as memory elements that can store more than one bit of data by using multiple units or different configurations. Some examples of such memory elements are registers, shift registers, counters, and memory cells. These memory elements can be used to implement more complex functions and systems in digital electronics.

Flip-flops are the basic building blocks of sequential logic circuits, which are widely used in computers, communications, and many other types of systems.