

Experiment No. 4

**Title: Conversion of one type of flip flop to other type of
flip-flop (J-K, D, and T flip-flop)**

Batch: B1

Roll No.: 16010420133

Experiment No.: 4

Aim: To study flip flops (J-K, D, and T flip flop) using IC 7476 and Conversion of one type of flip flop to other type of flip-flop (J-K, D, and T flip-flop)

Resources needed: Simulation Platform,

Vlab Link: <http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/experiments/verify-truth-table-of-flipflops-iitr/simulation.html>

Theory:

Theory: "Flip-flop" is the common name given to two-state devices which offer basic memory for sequential logic operations. Flip-flops are heavily used for digital data storage and transfer and are commonly used in banks called "registers" for the storage of binary numerical data.

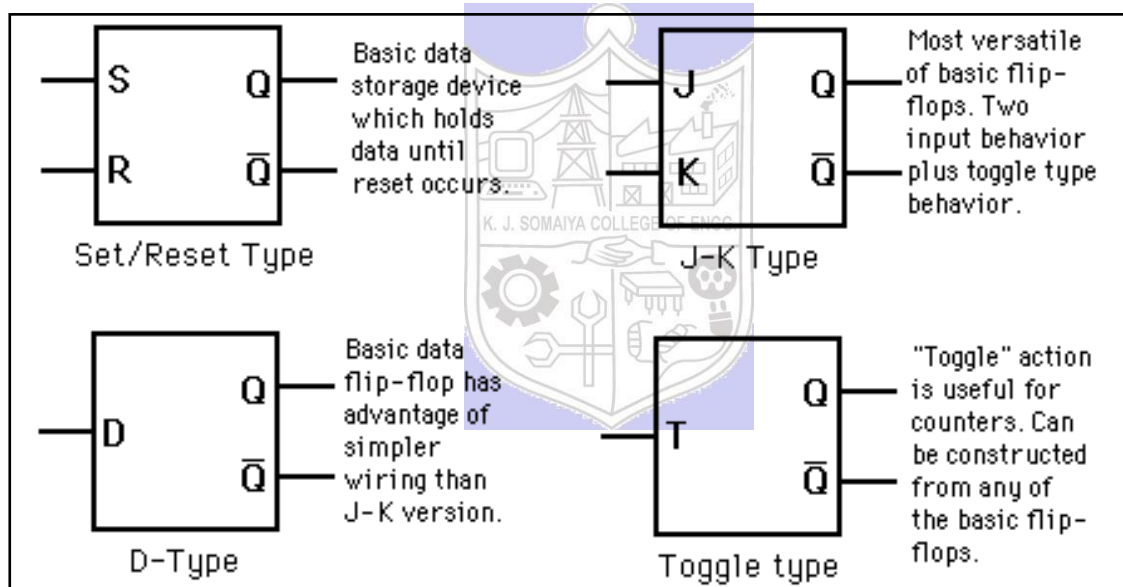


Fig: Types of Flip-flops

Set-Reset FlipFlop:

The set/reset type flip-flop is triggered to a high state at Q by the "set" signal and holds that value until reset to low by a signal at the Reset input. This can be implemented as a NAND gate latch or a NOR gate latch and as a clocked version.

One disadvantage of the S/R flip-flop is that the input $S=R=1$ gives ambiguous results and must be avoided. The J-K flip-flop gets around that problem.

JK FlipFlop:

JK-flip flop has two inputs, traditionally labeled J and K. IC 7476 is a dual JK master slave flip flop with preset and clear inputs. If J and K are different then the output Q takes the value of J at the next clock edge. If J and K are both low then no change occurs. If J and K are both high at the clock edge then the output will toggle from one state to the other. It can perform the functions of the set/reset flip-flop and has the advantage that there are no ambiguous states.

D FlipFlop:

D flip-flop tracks the input, making transitions with match those of the input D. The D stands for "data"; this flip-flop stores the value that is on the data line. It can be thought of as a basic memory cell. D flip-flop can be made from J-K flip-flop by connecting both inputs through a not gate as shown in fig.

T FlipFlop:

T or "toggle" flip-flop changes its output on each clock edge, giving an output which is half the frequency of the signal to the T input. It is useful for constructing binary counters, frequency dividers, and general binary addition devices. It can be made from a J-K flip-flop by tying both of its inputs high.

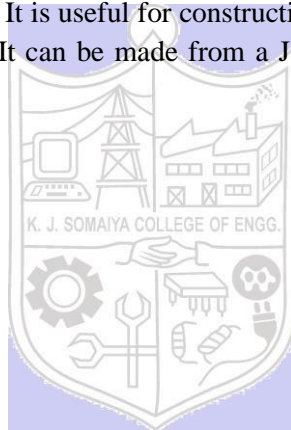


Table: Characteristic table and Excitation Table of flipflops

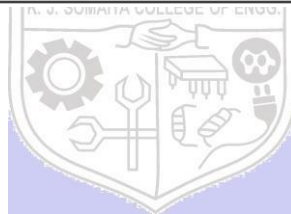
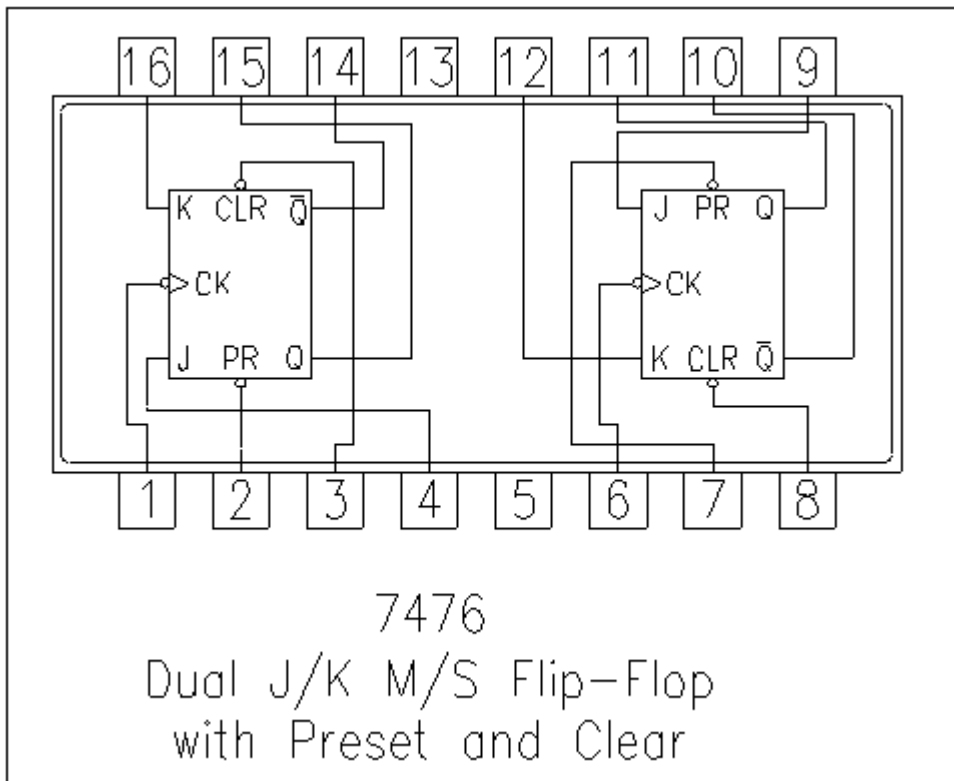
FlipFlop name	Characteristic Table			Characterist ic Equation	Excitation Table			
SR	S	R	Qnext	Qnext= S+R’Q	Q	Qnext	S	R
	0	0	Q		0	0	0	X
	0	1	0		0	1	1	0
	1	0	1		1	0	0	1
	1	1	Foribidden	Where SR=0	1	1	X	1
JK	J	K	Qnext	Qnext= JQ’+K’Q	Q	Qnext	J	K
	0	0	Q		0	0	0	X
	0	1	0		0	1	1	X
	1	0	1		1	0	X	1
	1	1	Q’(T)		1	1	X	0
D	D		Qnext	Qnext=D	Q	Qnext	D	
	0		0		0	0	0	
	1		1		0	1	1	
					1	0	0	
					1	1	1	
T	T		Qnext	Qnext= TQ’+T’Q	Q	Qnext	T	
	0		Q		0	0	0	
	1		Q’		0	1	1	
					1	0	1	
					1	1	0	

Procedure:

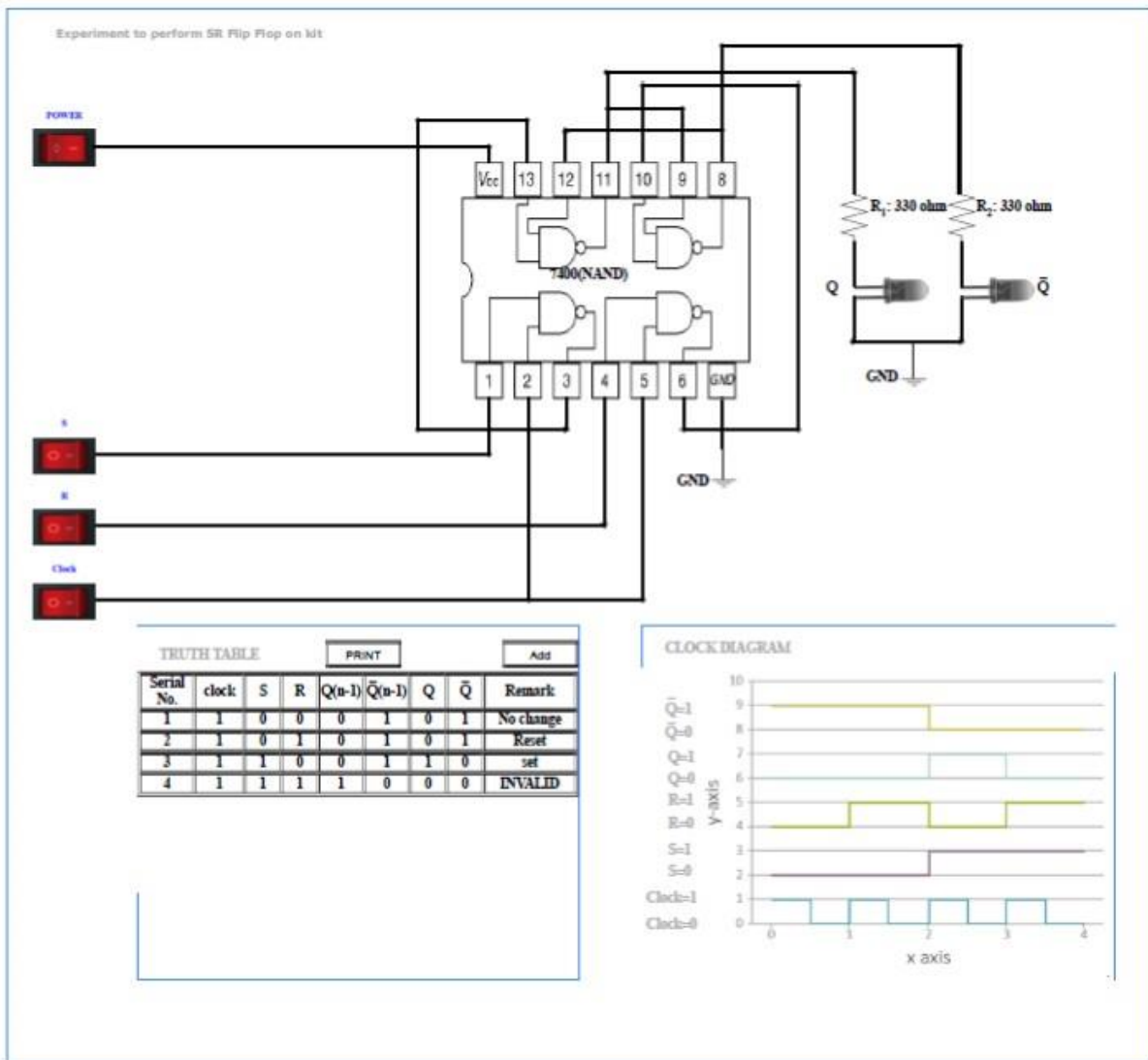
- Draw the pinout diagram of IC 7476
- Explore Vlab for SR, JK, D and T flipflop
Link for Vlab Simulation: [Virtual Labs \(iitb.ac.in\)](https://www.vlabs.io/)
- Convert JK flipflop to D and T flip. (Show the procedure on separate sheets.)
- Connect the J&K flipflop as D and T flip flop and verify the respective Characteristic Tables.

Observations and Results:

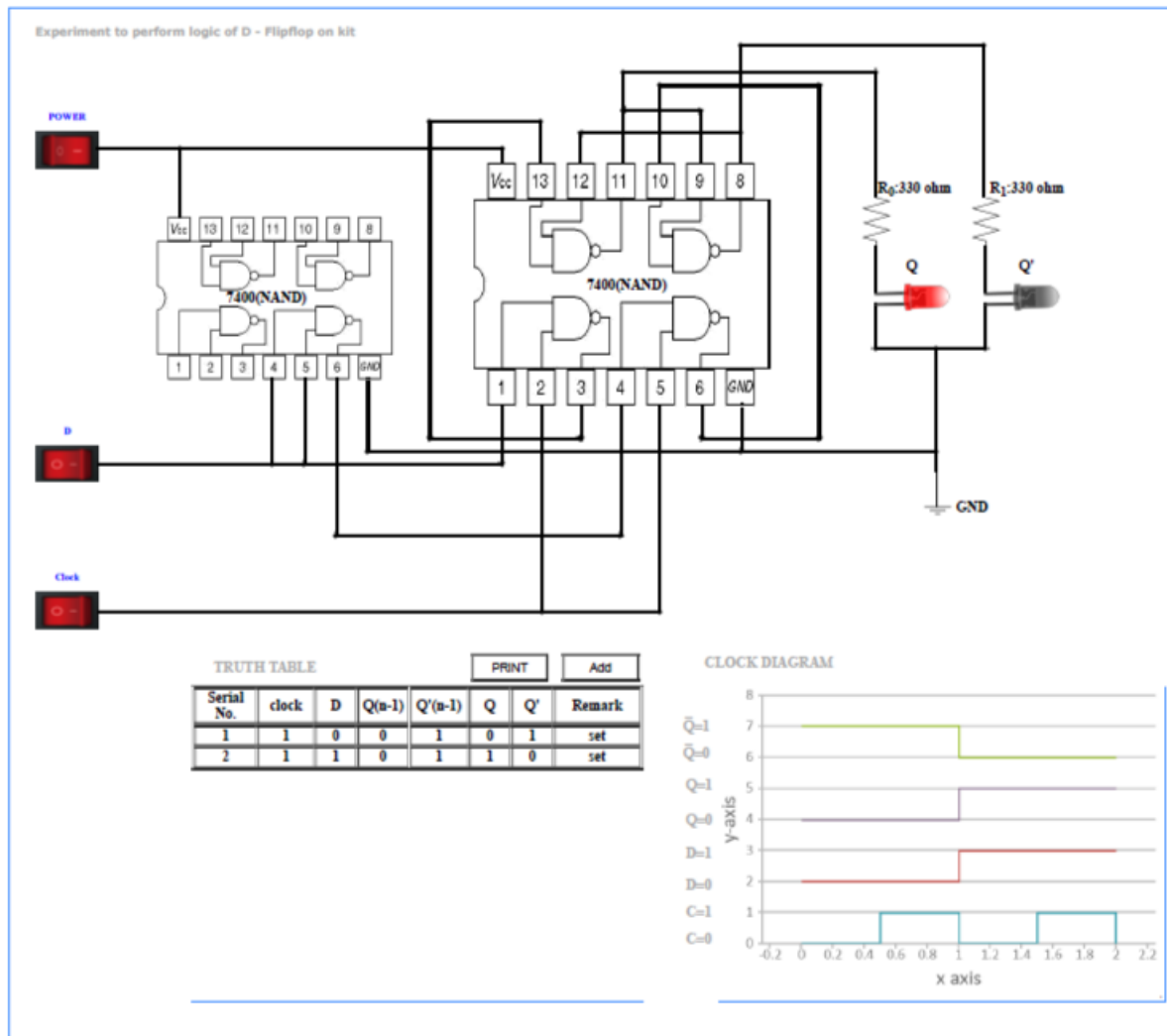
- Complete the Characteristic and Excitation Tables of SR, JK, T AND D flipflops.
- Observe and explore the Vlab Simulation.
- Show the conversion of JK flipflop to D and T flipflop.
- Observe the output for all the possible combinations of input.

IC 7476:

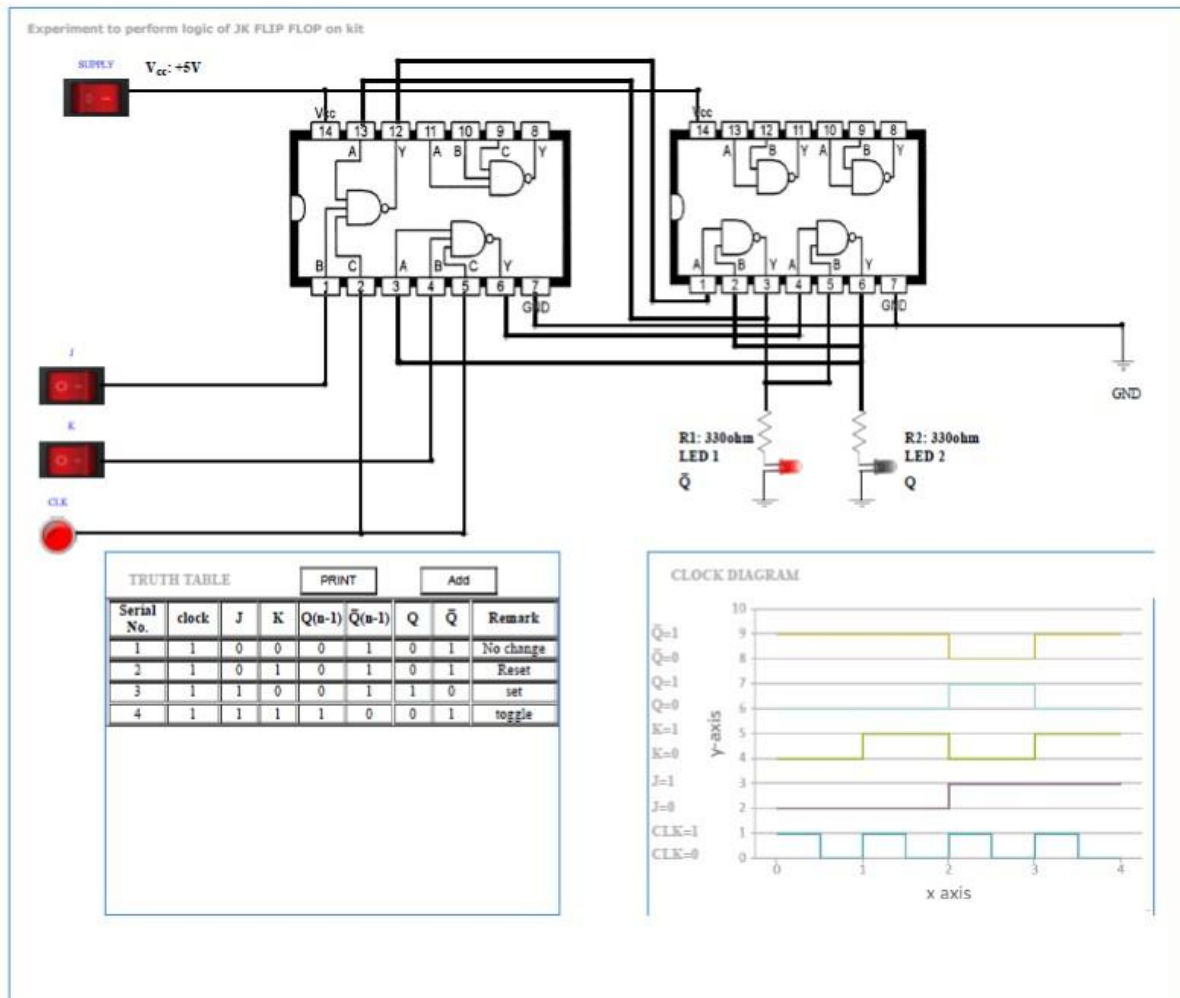
SR Flip Flop:

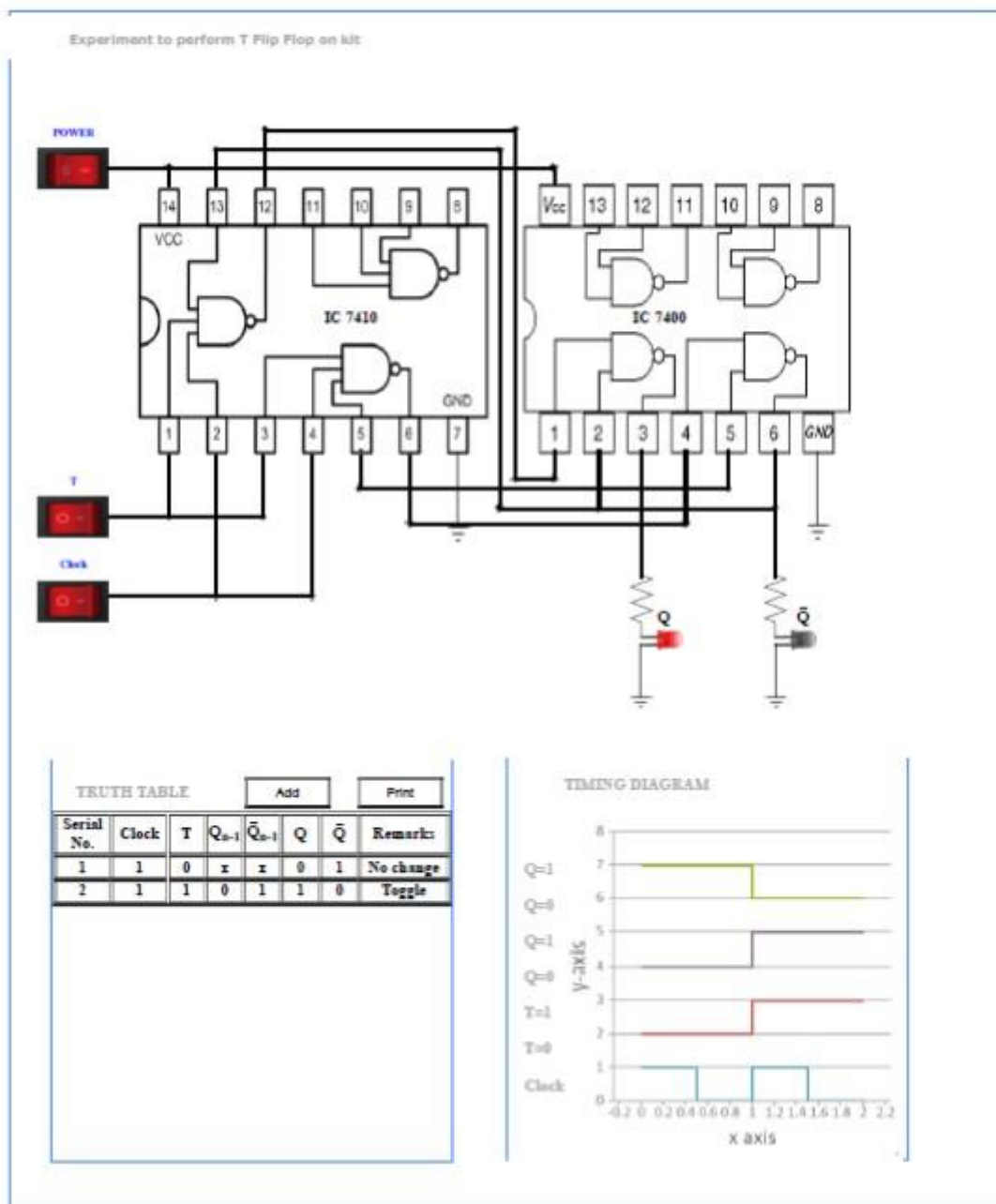


D Flip Flop:



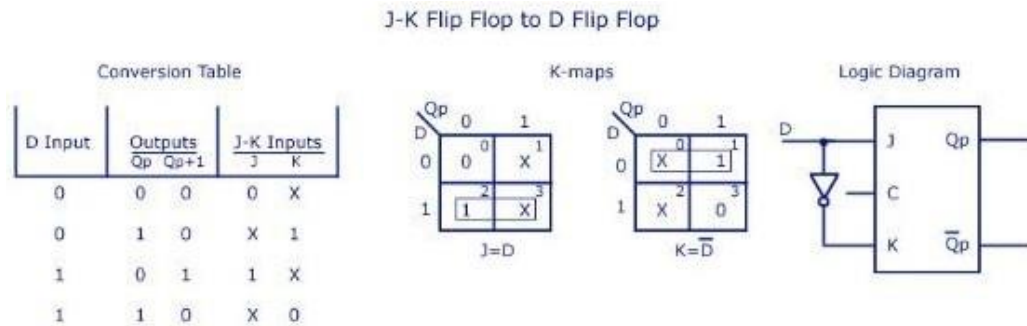
JK Flip Flop:



T Flip Flop:

1) Jk to D Flip Flop

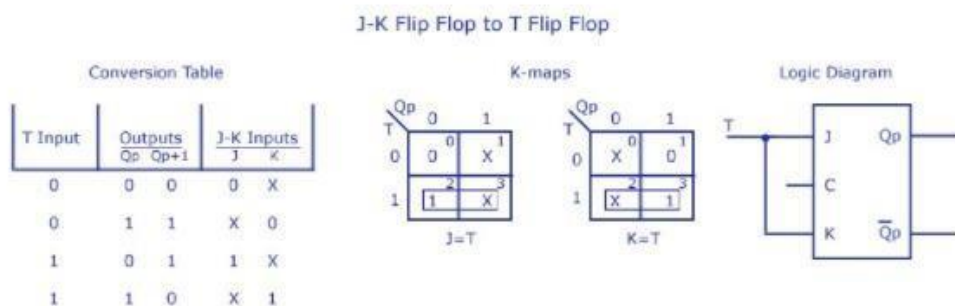
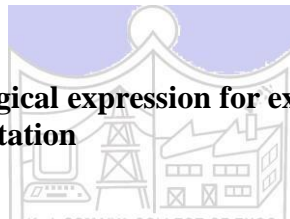
Procedure:- 1) Execute logical expression for excitation table of JK
2) Implementation



JK Flip Flop to D Flip Flop

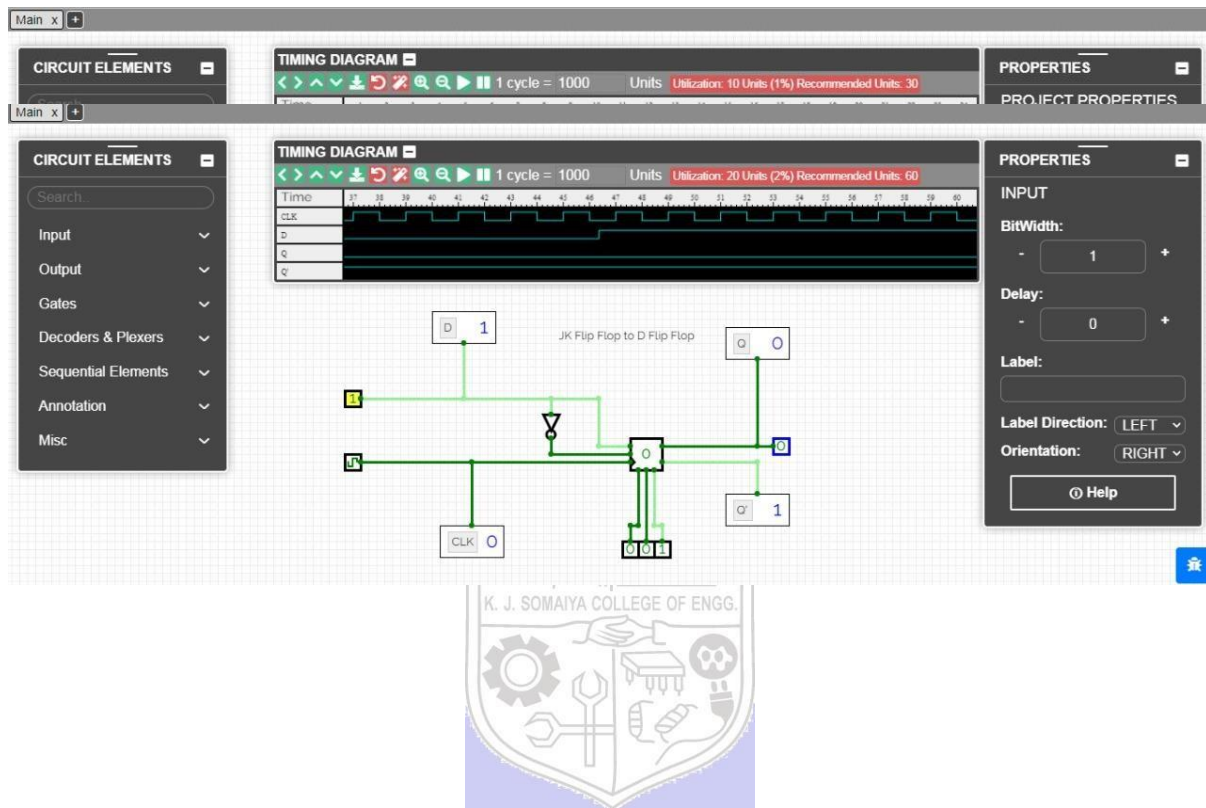
2) Jk to T Flip Flop

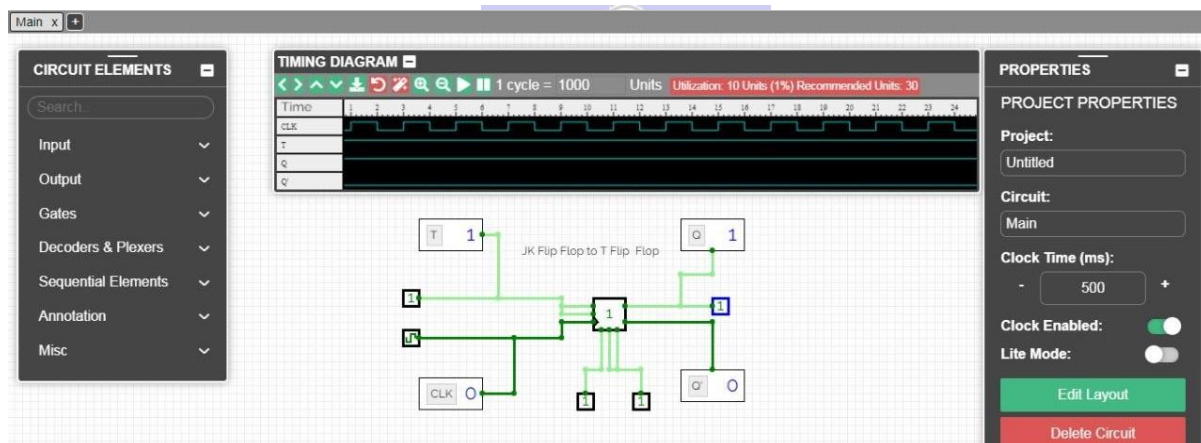
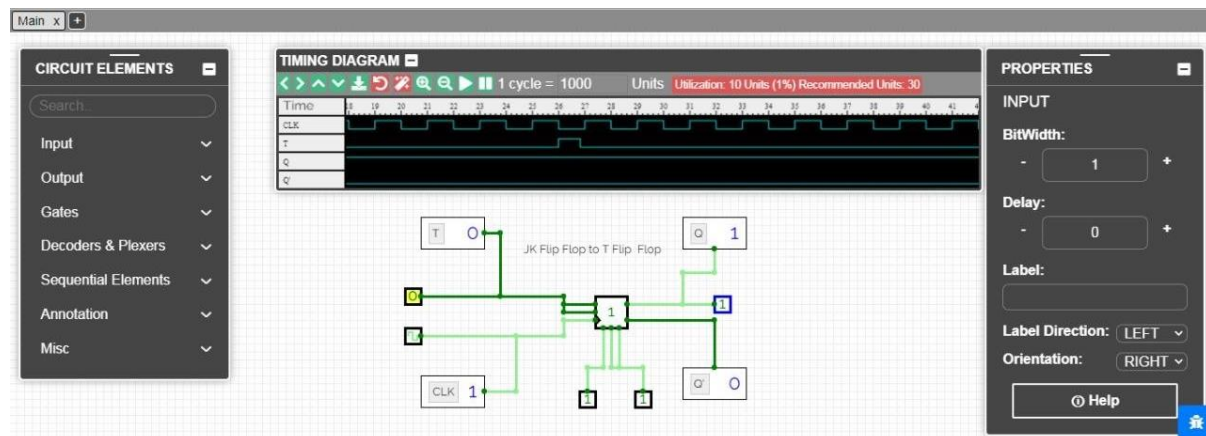
Procedure:- 1) Execute logical expression for excitation table of JK
2) Implementation



JK Flip Flop to T Flip Flop

CircuitVerse Simulation:





Outcomes:

CO: Design the combinational and sequential circuits using basic building blocks

Conclusion:

1. We have learned about flip-flops (J-K , D and T) using IC 7476.
2. Conversion of one type of flip flop to another type of flip-flop like JK-D and JK-T and verifying our results on Circuitverse.

Grade: AA / AB / BB / BC / CC / CD /DD

Signature of faculty in-charge with date

References:

Books/ Journals/ Websites:

1. Donald P Leach, Albert Paul Malvino “Digital principles and Applications” Tata McGraw Hill 8th Edition 2014
2. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill.
3. <http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/flipflop.html>

