Course Name:	**Digital Design Laboratory**	**Semester:**	**III**
Date of Performance:	___ / ___ / _____	**Batch No:**	**E2**
Faculty Name:		**Roll No:**	**16010123325**
Faculty Sign & Date:		**Grade/Marks:**	___/25

Experiment No: 5
Title: Flip Flops

Aim and Objective of the Experiment:
To Verify truth table of JK Flip flop using IC 7476 and study conversion of JK FF to D FF and T FF

COs to be achieved:
CO3: Design synchronous and asynchronous sequential circuits.

Tools used:
Trainer kits

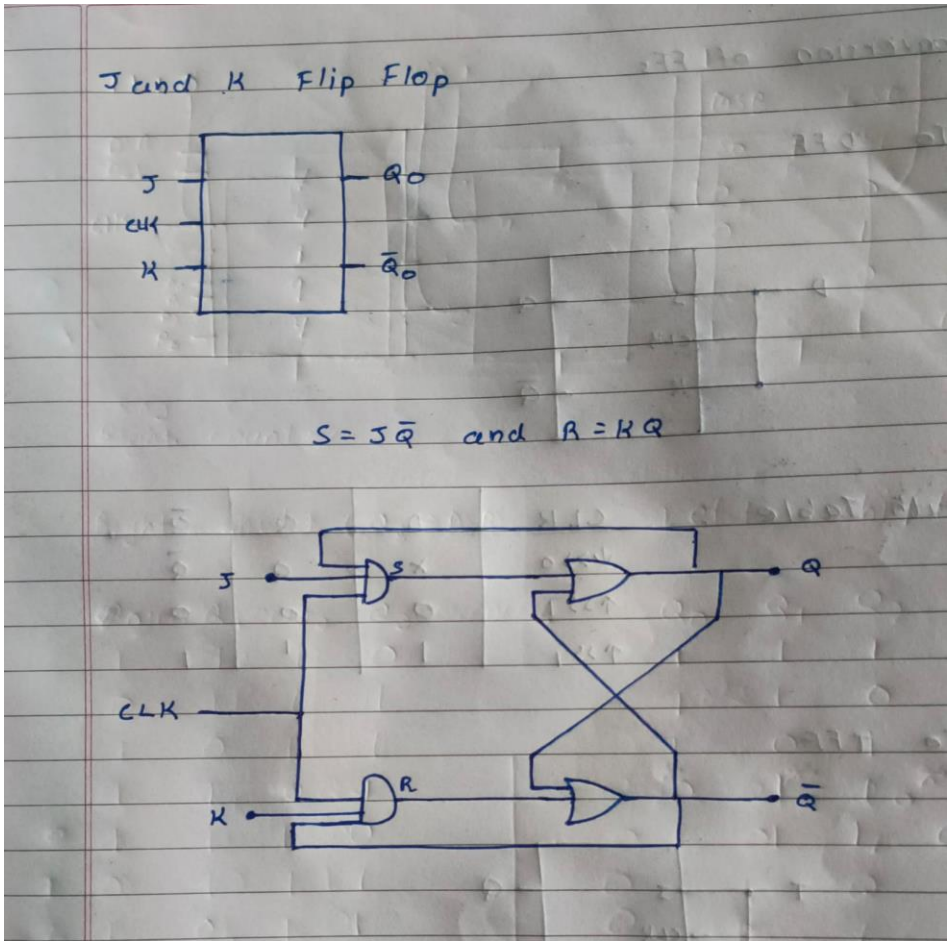
Theory:
Flip-flop is the common name given to two-state devices which offer basic memory for sequential logic operations. Flip-flops are heavily used for digital data storage and transfer and are commonly used in banks called "registers" for the storage of binary numerical data. **JK-flip flop:** has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

T Flip Flop: 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.

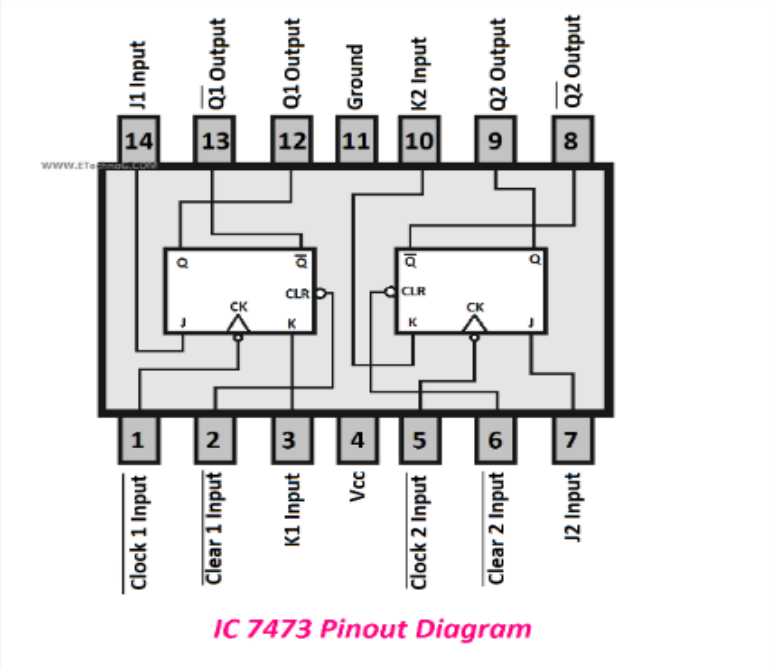
Implementation Details:
Procedure

1) Locate IC 7476 on Digital trainer kit
2) Apply various inputs to J & K pins by means of the output on logic output indicator.
3) Connect a pulsar switch to the clock input.
4) Connect the J&K as D and T flip flop as shown in diagrams and verify the respective truth tables.

Logic Symbol



Pin Diagram of IC 7476

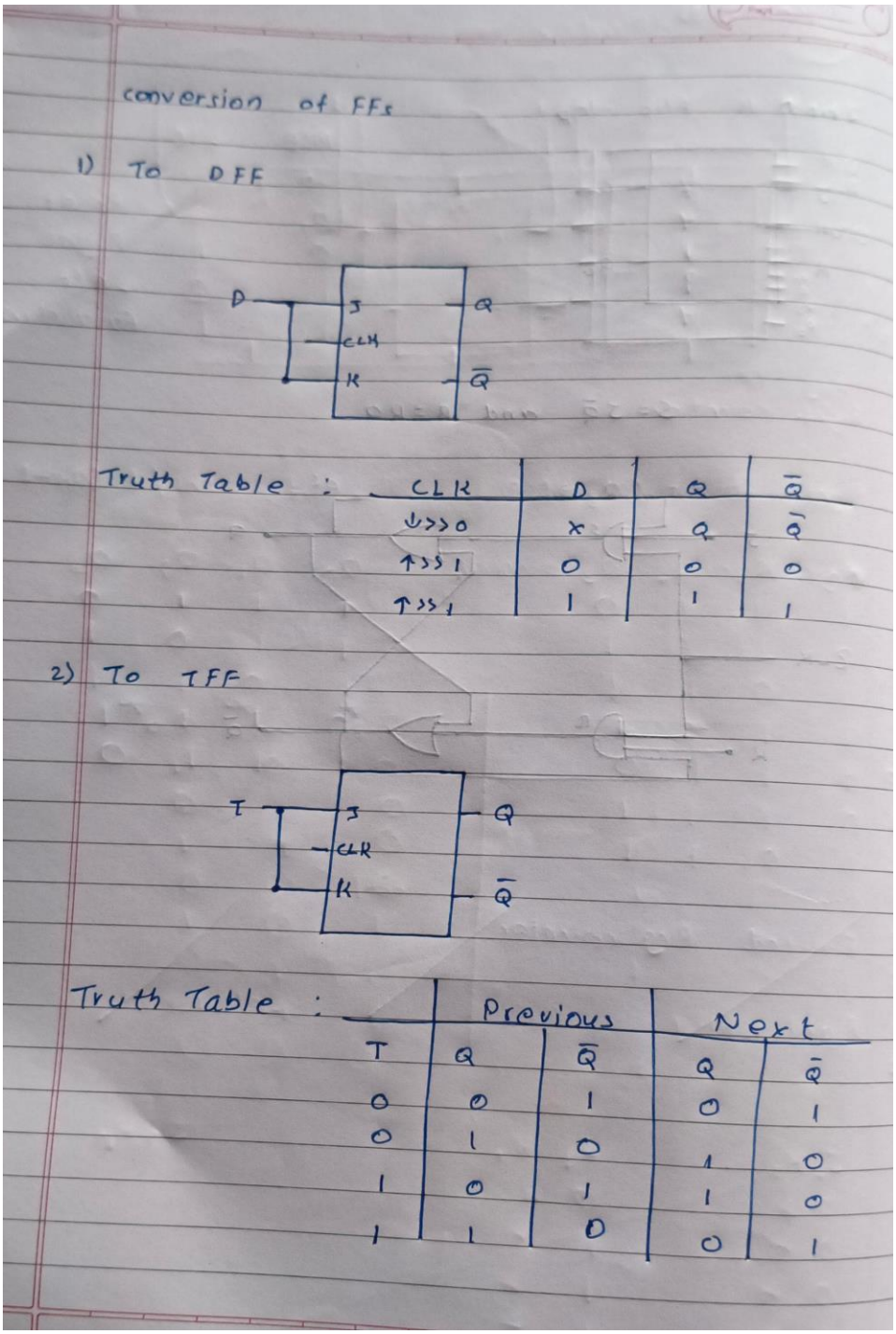


IC 7473 Pinout Diagram

Truth Table of JK FF

CLK	J	K	PR	CLR	Q	BAR(Q)
X	X	X	0	1	1	0
X	X	X	1	0	0	1
↑	0	0	1	1	Q	$\overline{Q}$
↑	0	1	1	1	0	1
↑	1	0	1	1	1	0
↑	1	1	1	1	$\overline{Q}$	Q

Conversion of FFs



Implementation Details
Procedure:

1) Locate the IC 7476 and place the IC on trainer kit.
2) Connect VCC and ground to respective pins of IC trainer kit.
3) Implement the circuit as shown in the circuit diagram.
4) Connect the inputs to the input switches provided in the trainer kit.
5) Connect the outputs to the switches of O/P LEDs
6) Apply various combinations of inputs according to the truth table and observe the condition of LEDs.
7) Note down the corresponding output readings for various combinations of inputs.

Post Lab Subjective/Objective type Questions:

1. How does a JK flip-flop differ from an SR flip-flop in its basic operation?

JK Flip-Flop: Can toggle its output; has inputs J (set) and K (reset) with states: No Change, Reset, Set, or Toggle.

SR Flip-Flop: Can only set or reset; has inputs S (set) and R (reset) with states: No Change, Set, or Reset.

2. What is the use of characteristic and excitation table?

Characteristic Table: Shows the relationship between flip-flop inputs and outputs for each state transition.

Excitation Table: Helps determine the necessary inputs to achieve a desired state transition in a flip-flop.

3. How many flip flops do you require storing the data 1101?

You need 4 flip-flops to store the 4-bit binary data 1101. Each flip-flop stores one bit.

4. Virtual Lab for Flipflop. Perform Simulation give feedback.
https://de-iitr.vlabs.ac.in/exp/truth-tables-flip-flops/simulation.html

Conclusion:

We verified the JK flip-flop truth table using IC 7476 and explored converting JK flip-flops to D and T flip-flops.

Signature of faculty in-charge with Date: