INDRAPRASTHA INSTITUTE *of*
INFORMATION TECHNOLOGY
DELHI

Department
of
Electronics & Communication Engineering

ECE111|Digital Circuits

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Lab_8:
FLIP-FLOPS

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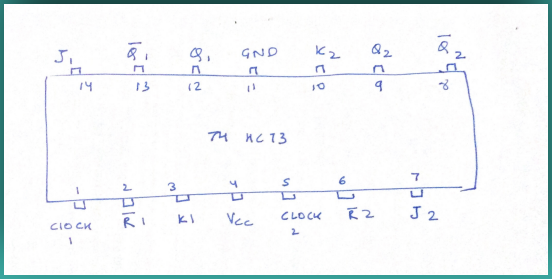
Part A. J-K FLIP-FLOP

Aim: Implement a J-K FLIP-FLOP in Tinkercad and verify its operation.

Components/ICs Used: Breadboard, Red LED, 1 kΩ Resistor, [5,5 Power Supply], Wire, slideswitch, dual JK flip-flop IC (74HC73), Function generator

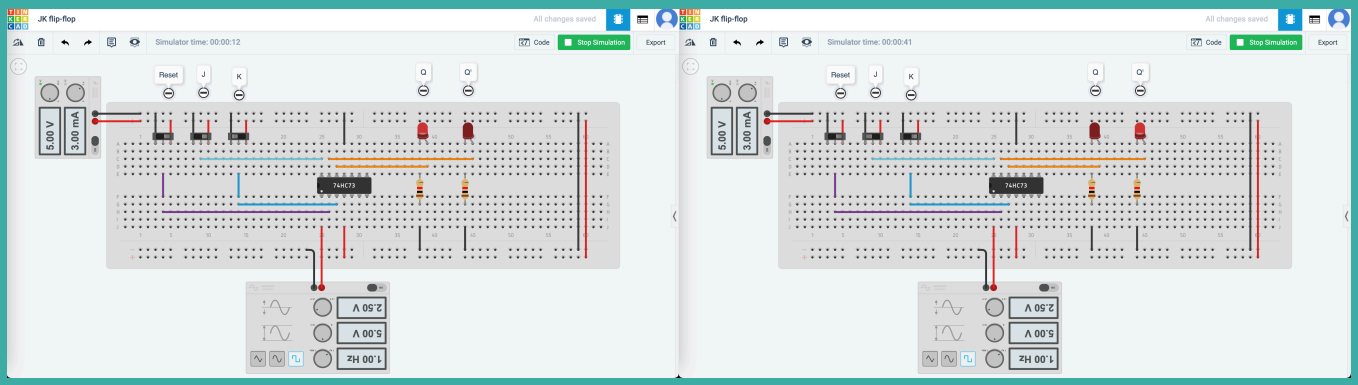
Link of TINKERCAD Workspace: https://www.tinkercad.com/things/2Wz1hR8iwL7

Pin Diagram:



74HC73

Circuit screenshot:



Characteristic Table:

J	K	Q_{n+1}	
0	0	Q_n	Hold
0	1	0	Reset
1	0	1	Set
1	1	Q_n'	Toggle

Transition Table:

J	K	Present	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

Characteristic equation:

		J K			
		0 0	0 1	1 1	1 0
Q_n	0	0	0	1	1
	1	1	0	0	1

$Q_{n+1} = Q'_n J + Q_n K'$

Excitation table:

Q_n	Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Observations/Results: The following values for Q and Q' are obtained for values of JK

J	K	Q	Q'	Justification
0	1	0	1	Reset
0	0	0	1	Hold
1	0	1	0	Set
0	0	1	0	Hold
0	1	0	1	Reset
1	1	Toggle	Toggle'	Toggle
1	0	1	0	Set
1	1	Toggle	Toggle'	Toggle
0	1	0	1	Reset

Applications of the experiment: JK flip flop is a refined and improved version of the SR flip flop.

1. Registers: A single flip flop can store a 1 bit word. Thus, by connecting a group of flip-flops, we can increase the storage capacity in terms of number of bits. Such a group of flip-flop is known as a **Register**.
2. Event Detectors: An Event detectors is a circuit which is capable of determining the occurrence of a particular event. These detectors change their state when an event occurs and retain in the same state till that event gets cleared . Flip-flops are well-known to preserve their state until the appearance of a suitable condition at their inputs, which means they can act as event detectors.

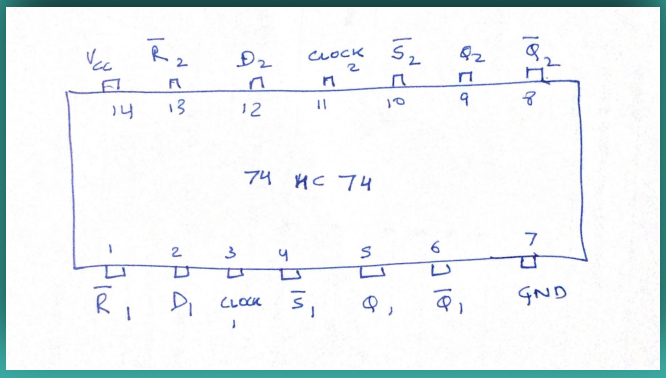
Part B. D FLIP-FLOP

Aim: Implement a D FLIP-FLOP in Tinkercad and verify its operation.

Components/ICs Used: Breadboard, Red LED, 1 kΩ Resistor, [5,5 Power Supply], Wire, slideswitch, dual D flip-flop IC (74HC74), Function generator

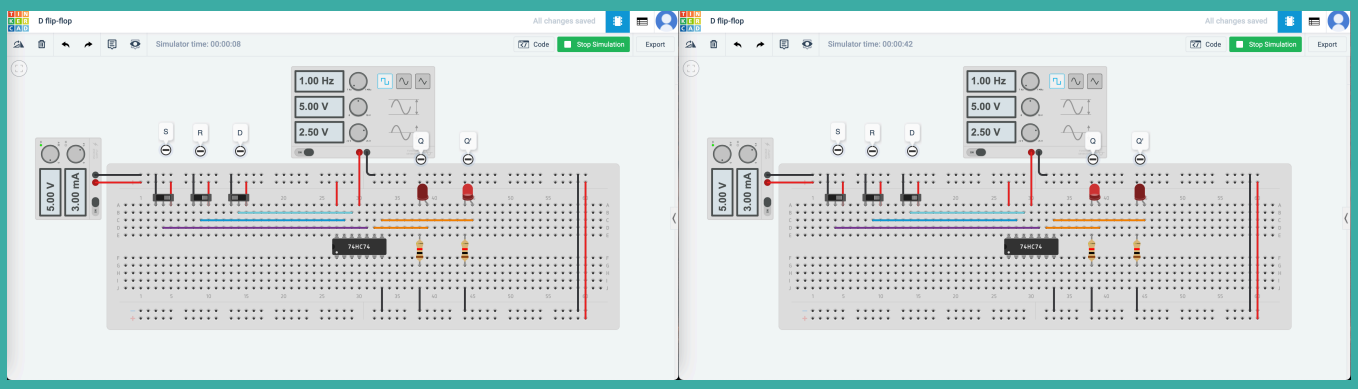
Link of TINKERCAD Workspace: https://www.tinkercad.com/things/9TQzvEPPGV1

Pin Diagram:



74HC74

Circuit screenshot:



Characteristic Table:

D	Q_{n+1}
0	0
1	1

Transition Table:

D	Present	Next
0	0	0
0	1	0
1	0	1
1	1	1

Characteristic equation:

		D	
		0	1
Q_n	0	0	1
	1	0	1

$Q_{n+1} = D$

Excitation table:

Q_n	Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1

Observations/Results: The following values for Q and Q' are obtained for values of D

D	Q	Q'	Justification
0	0	1	Q=D when S=R=1
1	1	0	
0	0	1	
1	1	0	

1. Counters: Counter is a digital circuit used for a counting pulses or number of events and it is the widest application of flip-flops . A Counter consists of a series of flip-flops (JK or D or T) arranged in a definite manner.
2.D flip-flop can be used to create delay-lines which are used in digital signal processing systems. This application arises readily due to the fact that the output at the synchronous D flip-flop is nothing but the input delayed by one-clock cycle. Thus by cascading n such flip-flops, output can be delayed by n clock cycles which in turn produces the required amount of delay.