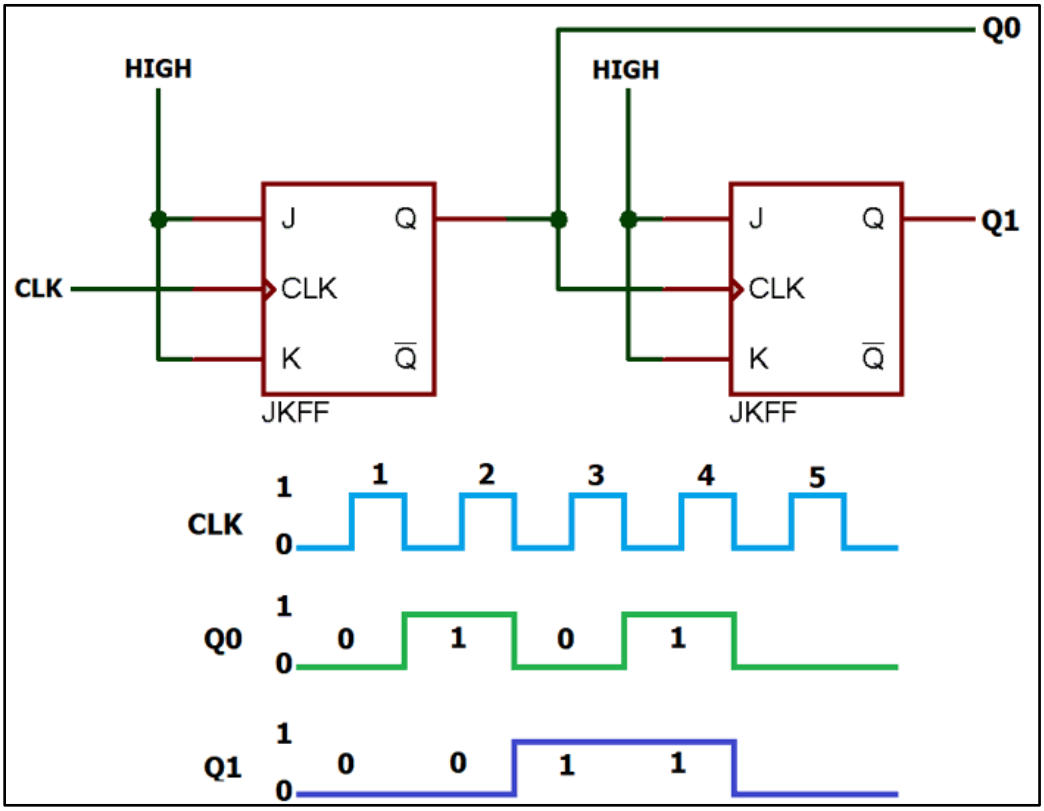
LAB 2: FlipFlop Counter

1. Exploring Flip-Flops in Logisim.

In Logisim, investigate the operational principles of the following types of flip-flops: SR-FF, D-FF, T-FF và JK-FF.

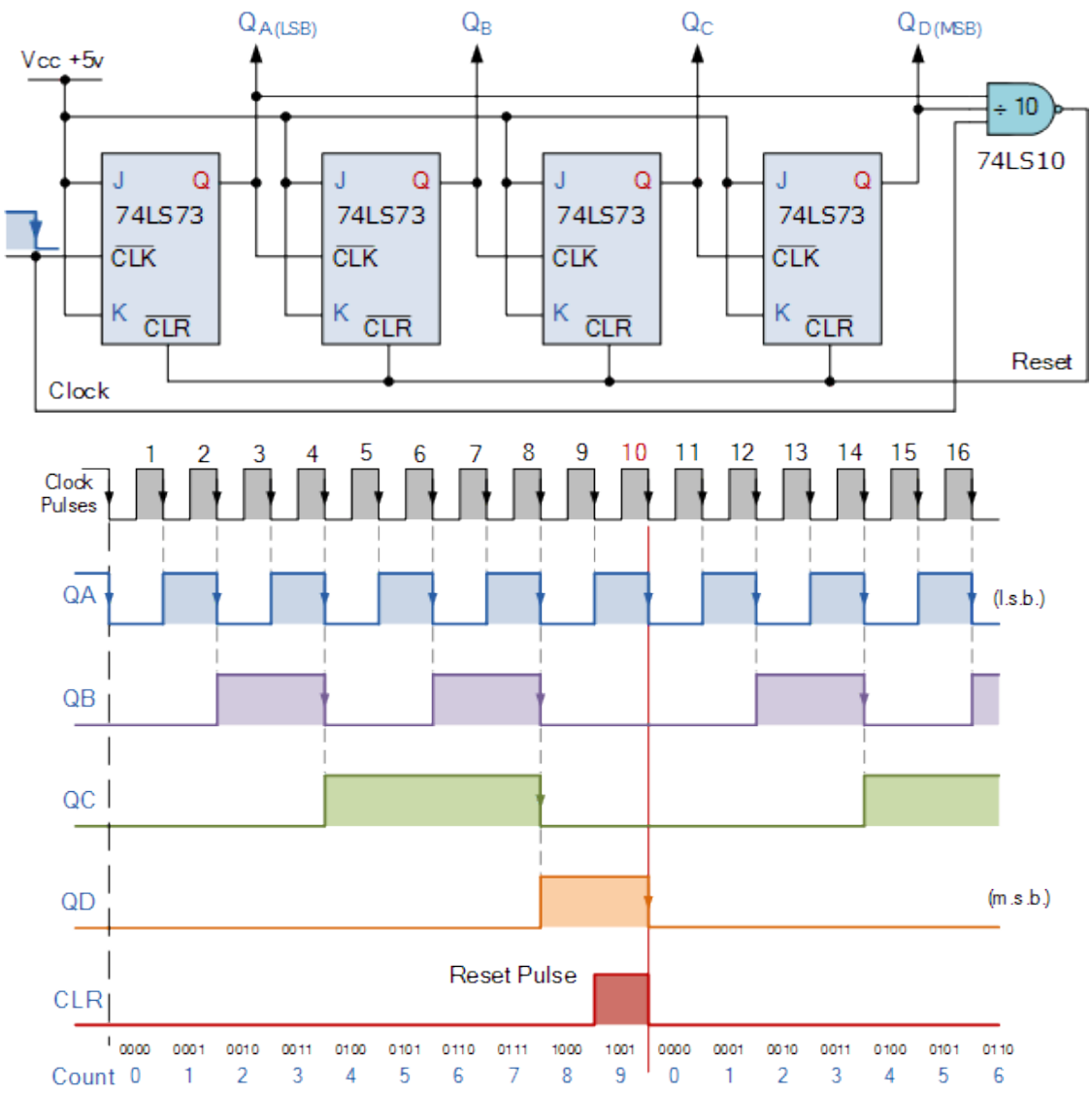
2. 2-bit Asynchonous Counter using Flop-Flops

Design a 2-bit asynchronous counter using JK Flip-Flops.



Using D Flip-Flops, design an asynchronous counter that counts from 0 to 15. Draw the clock waveform and corresponding Q outputs in a timing diagram.

3. Modulo-n Asynchonous Counter



Using JK Flip-Flops, implement an up counter that counts up to 12.

4. Synchronous Counter using Flip-Flops.

To design a 3-bit synchronous counter using D Flip-Flops, follow these steps:

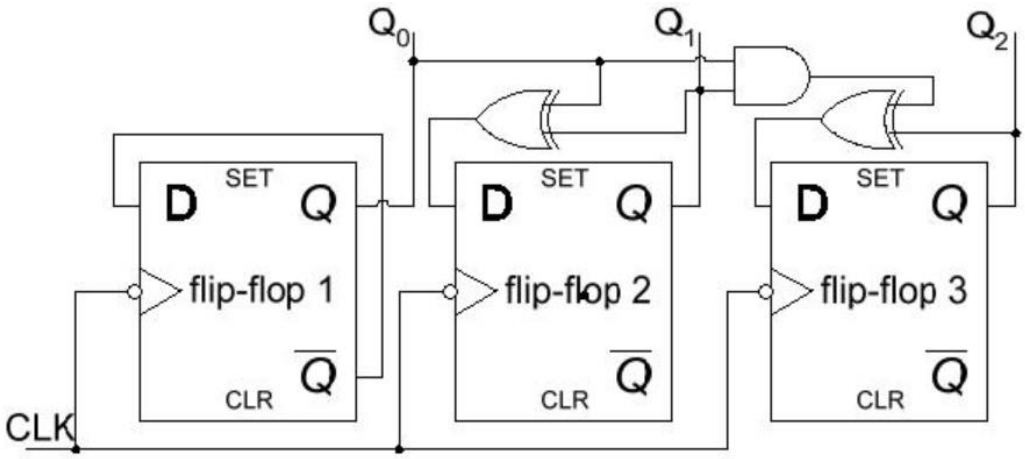
- Step 1: Construct a state transisition table and determine the D inputs for the D Flip-Flops.

Present State			Next State			D flip-flop inputs		
Q_2	Q_1	Q_0	Q_2	Q_1	Q_0	D_2	D_1	D_0
0	0	0	0	0	1	0	0	1
0	0	1	0	1	0	0	1	0
0	1	0	0	1	1	0	1	1
0	1	1	1	0	0	1	0	0
1	0	0	1	0	1	1	0	1
1	0	1	1	1	0	1	1	0
1	1	0	1	1	1	1	1	1
1	1	1	0	0	0	0	0	0

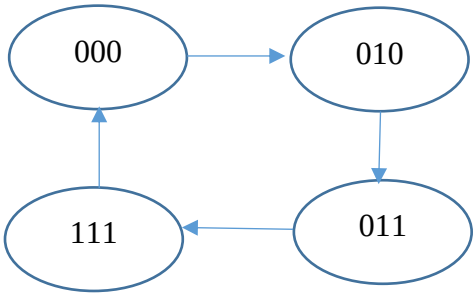
- Step 2: Create Karnaugh maps for the D inputs based on the Q output variables.

Q_2Q_1/Q_0	0	1
00	0	0
01	0	1
11	1	0
10	1	1

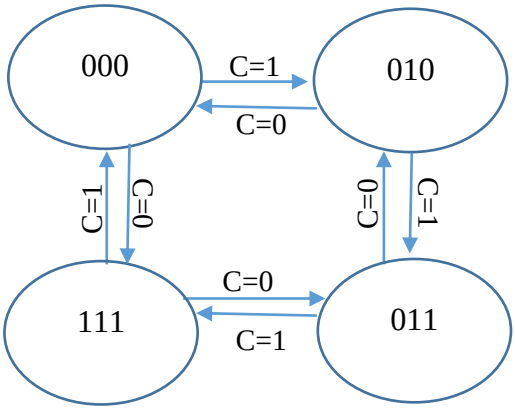
Step 3: Derive the boolean expressions for the D inputs from the Karnaugh maps and implement the circuit.



Based on the design above, create a 3-bit synchronous counter using D Flip-Flops with the states shown in the figure below.



5. Design a synchronous counter using JK Flip-Flop with state transitions shown in the diagram below.Control bit C=1 the couter change state in a clockwise direction and counter clockwise with C=0.



6. Examine the operation of the counter component in Logisim. Use the counter component to create a clock. The clock have minute and second with 7-segment LED display. Additional functionality for setting the time is encoraged.

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