



# **SNS COLLEGE OF TECHNOLOGY**

**Coimbatore-35**  
**An Autonomous Institution**



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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## **DEPARTMENT OF MECHATRONICS ENGINEERING**

### **19MCT201 - DESIGN OF DIGITAL CIRCUITS**

**II YEAR - III SEM**

### **UNIT 3 – SEQUENTIAL CIRCUITS**

**TOPIC 2 –Counter**



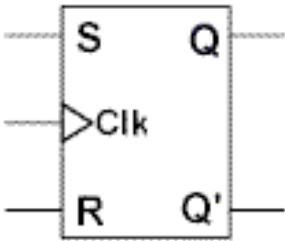
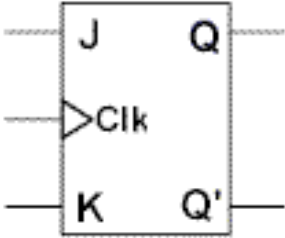
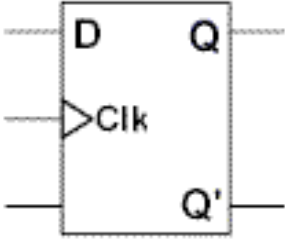
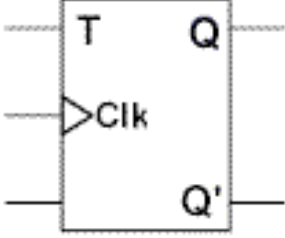
# SEQUENTIAL CIRCUITS



Latches, Edge triggered Flip flops SR, JK, T, D and Master slave – Characteristic table and equation, Application table, Synchronous counters, Design of synchronous counters, up/down counter, Modulo–n counter, Decade counters. Design of Sequential circuits using simulation

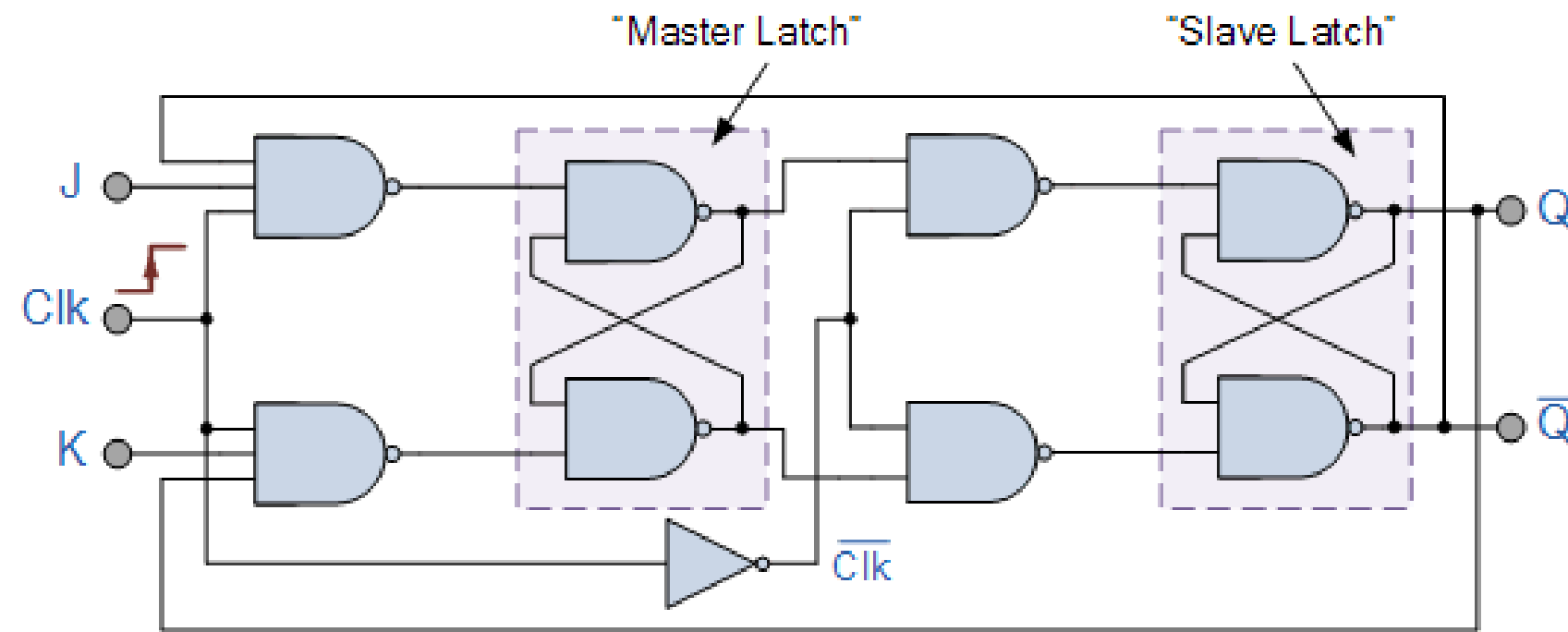


# Flip flops

| FLIP-FLOP NAME | FLIP-FLOP SYMBOL                                                                    | CHARACTERISTIC TABLE                                                                                                                                                                                                                 | CHARACTERISTIC EQUATION | EXCITATION TABLE    |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|---------------------|---|---|----|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------|---|---|---|---|----|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SR             |    | <table><tr><th>S</th><th>R</th><th>Q<sub>(next)</sub></th></tr><tr><td>0</td><td>0</td><td>Q</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>?</td></tr></table>  | S                       | R                   | Q <sub>(next)</sub> | 0 | 0 | Q  | 0                        | 1                                                                                                                                                                                                                                   | 0 | 1                   | 0 | 1 | 1 | 1 | ?  | $Q_{(next)} = S + R'Q$<br>$SR = 0$ | <table><tr><th>Q</th><th>Q<sub>(next)</sub></th><th>S</th><th>R</th></tr><tr><td>0</td><td>0</td><td>0</td><td>X</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>X</td><td>0</td></tr></table> | Q | Q <sub>(next)</sub> | S | R | 0 | 0 | 0 | X | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | X | 0 |
| S              | R                                                                                   | Q <sub>(next)</sub>                                                                                                                                                                                                                  |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | Q                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | ?                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Q              | Q <sub>(next)</sub>                                                                 | S                                                                                                                                                                                                                                    | R                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | 0                                                                                                                                                                                                                                    | X                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 1                                                                                                                                                                                                                                    | 0                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | 0                                                                                                                                                                                                                                    | 1                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | X                                                                                                                                                                                                                                    | 0                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| JK             |    | <table><tr><th>J</th><th>K</th><th>Q<sub>(next)</sub></th></tr><tr><td>0</td><td>0</td><td>Q</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>Q'</td></tr></table> | J                       | K                   | Q <sub>(next)</sub> | 0 | 0 | Q  | 0                        | 1                                                                                                                                                                                                                                   | 0 | 1                   | 0 | 1 | 1 | 1 | Q' | $Q_{(next)} = JQ' + K'Q$           | <table><tr><th>Q</th><th>Q<sub>(next)</sub></th><th>J</th><th>K</th></tr><tr><td>0</td><td>0</td><td>0</td><td>X</td></tr><tr><td>0</td><td>1</td><td>1</td><td>X</td></tr><tr><td>1</td><td>0</td><td>X</td><td>1</td></tr><tr><td>1</td><td>1</td><td>X</td><td>0</td></tr></table> | Q | Q <sub>(next)</sub> | J | K | 0 | 0 | 0 | X | 0 | 1 | 1 | X | 1 | 0 | X | 1 | 1 | 1 | X | 0 |
| J              | K                                                                                   | Q <sub>(next)</sub>                                                                                                                                                                                                                  |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | Q                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | Q'                                                                                                                                                                                                                                   |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Q              | Q <sub>(next)</sub>                                                                 | J                                                                                                                                                                                                                                    | K                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | 0                                                                                                                                                                                                                                    | X                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 1                                                                                                                                                                                                                                    | X                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | X                                                                                                                                                                                                                                    | 1                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | X                                                                                                                                                                                                                                    | 0                       |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| D              |  | <table><tr><th>D</th><th>Q<sub>(next)</sub></th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td></tr></table>                                                                                                              | D                       | Q <sub>(next)</sub> | 0                   | 0 | 1 | 1  | $Q_{(next)} = D$         | <table><tr><th>Q</th><th>Q<sub>(next)</sub></th><th>D</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table> | Q | Q <sub>(next)</sub> | D | 0 | 0 | 0 | 0  | 1                                  | 1                                                                                                                                                                                                                                                                                     | 1 | 0                   | 0 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| D              | Q <sub>(next)</sub>                                                                 |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Q              | Q <sub>(next)</sub>                                                                 | D                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| T              |  | <table><tr><th>T</th><th>Q<sub>(next)</sub></th></tr><tr><td>0</td><td>Q</td></tr><tr><td>1</td><td>Q'</td></tr></table>                                                                                                             | T                       | Q <sub>(next)</sub> | 0                   | Q | 1 | Q' | $Q_{(next)} = TQ' + T'Q$ | <table><tr><th>Q</th><th>Q<sub>(next)</sub></th><th>T</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table> | Q | Q <sub>(next)</sub> | T | 0 | 0 | 0 | 0  | 1                                  | 1                                                                                                                                                                                                                                                                                     | 1 | 0                   | 1 | 1 | 1 | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| T              | Q <sub>(next)</sub>                                                                 |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | Q                                                                                   |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | Q'                                                                                  |                                                                                                                                                                                                                                      |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Q              | Q <sub>(next)</sub>                                                                 | T                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 0                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0              | 1                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 0                                                                                   | 1                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1              | 1                                                                                   | 0                                                                                                                                                                                                                                    |                         |                     |                     |   |   |    |                          |                                                                                                                                                                                                                                     |   |                     |   |   |   |   |    |                                    |                                                                                                                                                                                                                                                                                       |   |                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |



# The Master-Slave JK Flip Flop



The circuit accepts input data when the clock signal is “HIGH”, and passes the data to the output on the falling-edge of the clock signal. In other words, the **Master-Slave JK Flip flop** is a “Synchronous” device as it only passes data with the timing of the clock signal.

The input signals J and K are connected to the gated “master” SR flip flop which “locks” the input condition while the clock (Clk) input is “HIGH” at logic level “1”. As the clock input of the “slave” flip flop is the inverse (complement) of the “master” clock input, the “slave” SR flip flop does not toggle. The outputs from the “master” flip flop are only “seen” by the gated “slave” flip flop when the clock input goes “LOW” to logic level “0”.

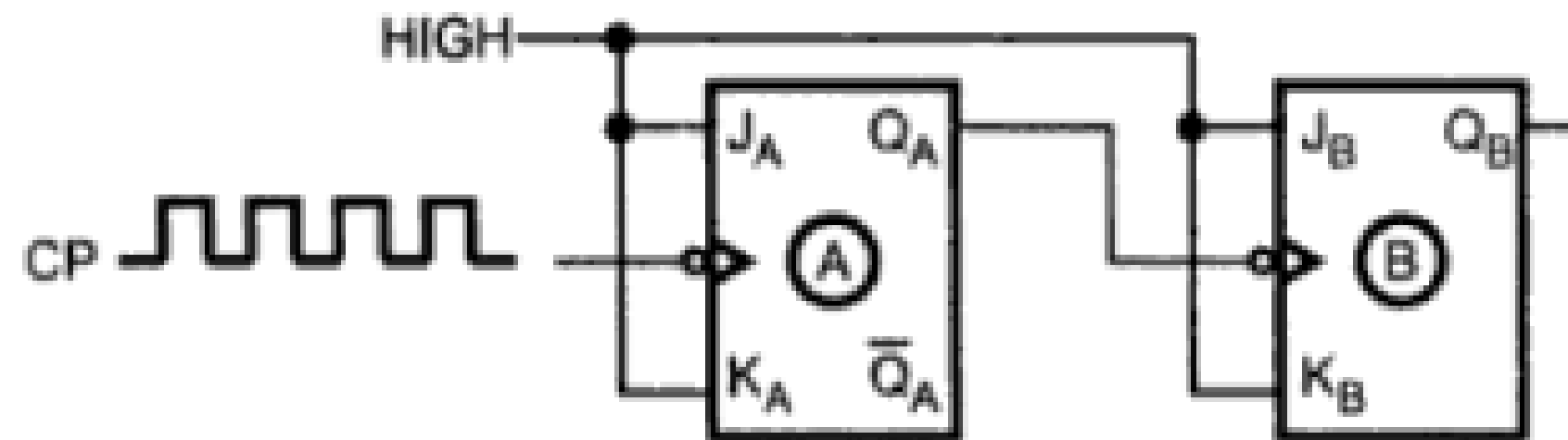
When the clock is “LOW”, the outputs from the “master” flip flop are latched and any additional changes to its inputs are ignored. The gated “slave” flip flop now responds to the state of its inputs passed over by the “master” section.



# Counters

A counter is a register capable of counting the number of clock pulses arriving at its clock input. Count represents the number of clock pulses arrived. A specified sequence of states appears as the counter output. This is the main difference between a register and a counter. A specified sequence of states is different for different types of counters.

There are two types of counters, synchronous and asynchronous.



**A two-bit asynchronous binary counter**



# Counters



## Design of Synchronous Counter

1. Obtain the transition table from the given circuit information.
2. Determine the number of flip-flops needed.
3. Choose the type of flip-flops to be used.
4. From the transition table, derive the circuit excitation table.
5. Use K-map or any other simplification method to derive the circuit the flip-flop input functions.
6. Draw the logic diagram.



# Counters

## Design of a Synchronous Mod-6 Counter using Clocked JK Flip-Flops

**Step 1 :** Find number of flip-flops required to build the counter :

Flip-Flops required are :  $2^n \geq N$ .

Here  $N = 6 \therefore n = 3$

i.e. three flip-flops are required.

**Step 2 :** Write an excitation table for JK flip-flop.

| $Q_n$ | $Q_{n+1}$ | J | K |
|-------|-----------|---|---|
| 0     | 0         | 0 | X |
| 0     | 1         | 1 | X |
| 1     | 0         | X | 1 |
| 1     | 1         | X | 0 |

**Step 3 :** Determine the transition table.

| Present state |       |       | Next state |           |           | Flip-flop inputs |       |       |       |       |       |
|---------------|-------|-------|------------|-----------|-----------|------------------|-------|-------|-------|-------|-------|
| $Q_A$         | $Q_B$ | $Q_C$ | $Q_{A+1}$  | $Q_{B+1}$ | $Q_{C+1}$ | $J_A$            | $K_A$ | $J_B$ | $K_B$ | $J_C$ | $K_C$ |
| 0             | 0     | 0     | 0          | 0         | 1         | 0                | x     | 0     | x     | 1     | x     |
| 0             | 0     | 1     | 0          | 1         | 0         | 0                | x     | 1     | x     | x     | 1     |
| 0             | 1     | 0     | 0          | 1         | 1         | 0                | x     | x     | 0     | 1     | x     |
| 0             | 1     | 1     | 1          | 0         | 0         | 1                | x     | x     | 1     | x     | 1     |
| 1             | 0     | 0     | 1          | 0         | 1         | x                | 0     | 0     | x     | 1     | x     |
| 1             | 0     | 1     | 0          | 0         | 0         | x                | 1     | 0     | x     | x     | 1     |
| 1             | 1     | 0     | x          | x         | x         | x                | x     | x     | x     | x     | x     |
| 1             | 1     | 1     | x          | x         | x         | x                | x     | x     | x     | x     | x     |



# Counters

## Design of a Synchronous Mod-6 Counter using Clocked JK Flip-Flops

Step 4 : K-map simplification for flip-flop inputs.

For  $J_A$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | 0  | 0  | 1  | 0  |
| 1         | X  | X  | X  | X  |

$$J_A = Q_B Q_C$$

For  $K_A$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | X  | X  | X  | X  |
| 1         | 0  | 1  | X  | X  |

$$K_A = Q_C$$

For  $J_B$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | 0  | 1  | X  | X  |
| 1         | 0  | 0  | X  | X  |

$$J_B = \bar{Q}_A Q_C$$

For  $K_B$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | X  | X  | 1  | 0  |
| 1         | X  | X  | X  | X  |

$$K_B = Q_C$$

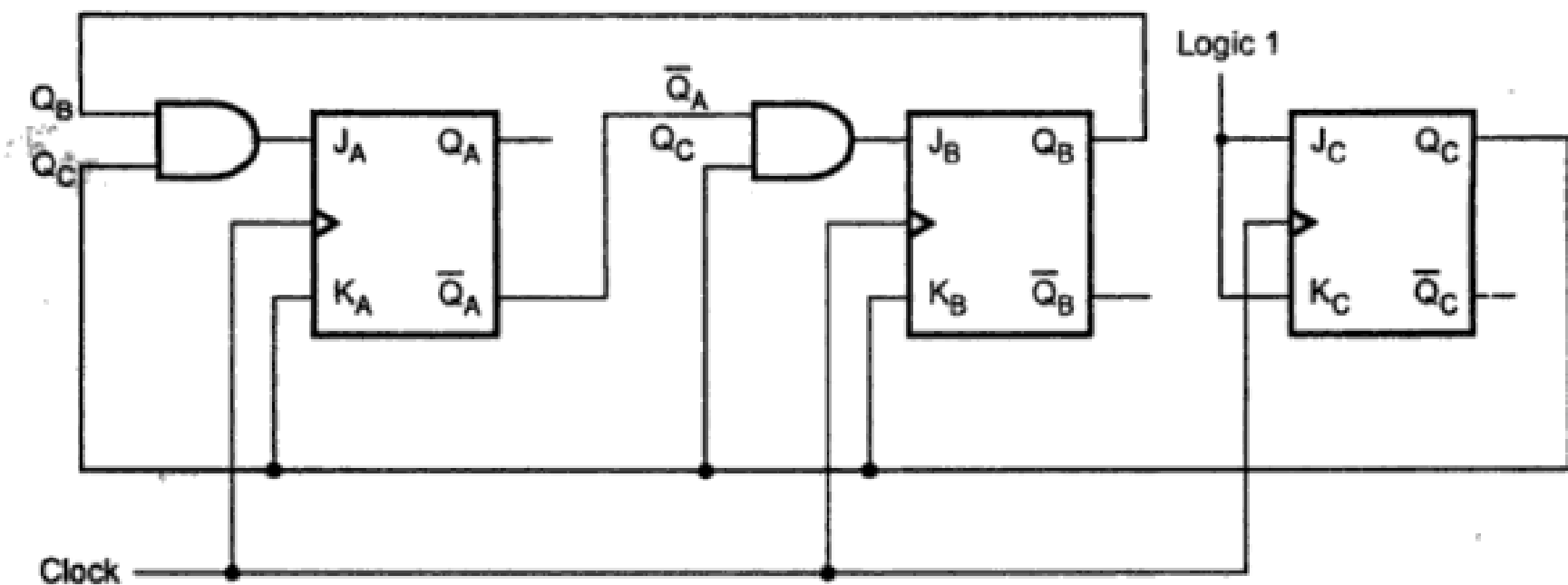
For  $J_C$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | 1  | X  | X  | 1  |
| 1         | 1  | X  | X  | X  |

For  $K_C$

| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
|-----------|----|----|----|----|
| 0         | X  | 1  | 1  | X  |
| 1         | X  | 1  | X  | X  |

Step 5 : Implement the counter.





# ASSESSMENT - 1

Mux relates with us....

## Question 1

**Which combinational circuit is renowned for selecting a single input from multiple inputs & directing the binary information to output line?**

- ▶ a) Data Selector
- ▶ b) Data distributor
- ▶ c) Both data selector and data distributor
- ▶ d) DeMultiplexer

## Question 2

**Which is the major functioning responsibility of the multiplexing combinational circuit?**

- ▶ a) Decoding the binary information
- ▶ b) Generation of all minterms in an output function with OR-gate
- ▶ c) Generation of selected path between multiple sources and a single destination
- ▶ d) Encoding of binary information



# References

- <https://brilliant.org/wiki/de-morgans-laws/>
- <https://circuitglobe.com/demorgans-theorem.html>
- <https://www.electrical4u.com/>