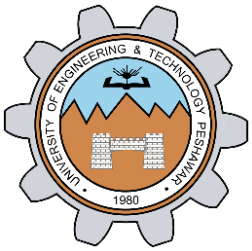
DLD

LAB # 11



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"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: _____

Submitted to:

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DEPARTMENT OF COMPUTER SYSTEMS ENGINEERING

RIPPLE COUNTERS

OBJECTIVES:

After completing this experiment, you will be able to:

- Design and verify a 4-bit Ripple Counter
- Design and verify MOD-10 and MOD-12 Ripple Counter
- Explain how a Ripple Counter can be used as a frequency divider

EQUIPMENT:

- Dc power supply
- Breadboard

COMPONENTS:

- IC 7400 quad 2-input NAND gate
- IC 7476 JK FLIP FLOP
- LEDs
- DIP switch
- Wires

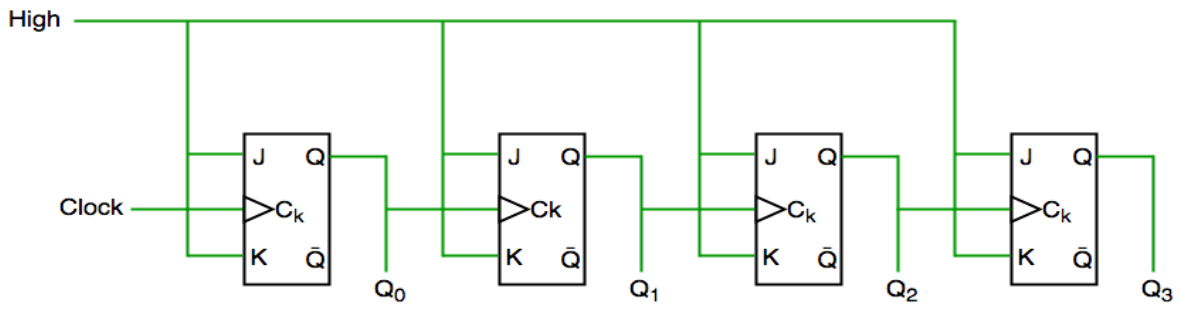
THEORY:

A circuit used for counting the pulses is known as Counter. Basically there are two types of Counters: Asynchronous Counters (Ripple Counters) and Synchronous Counters.

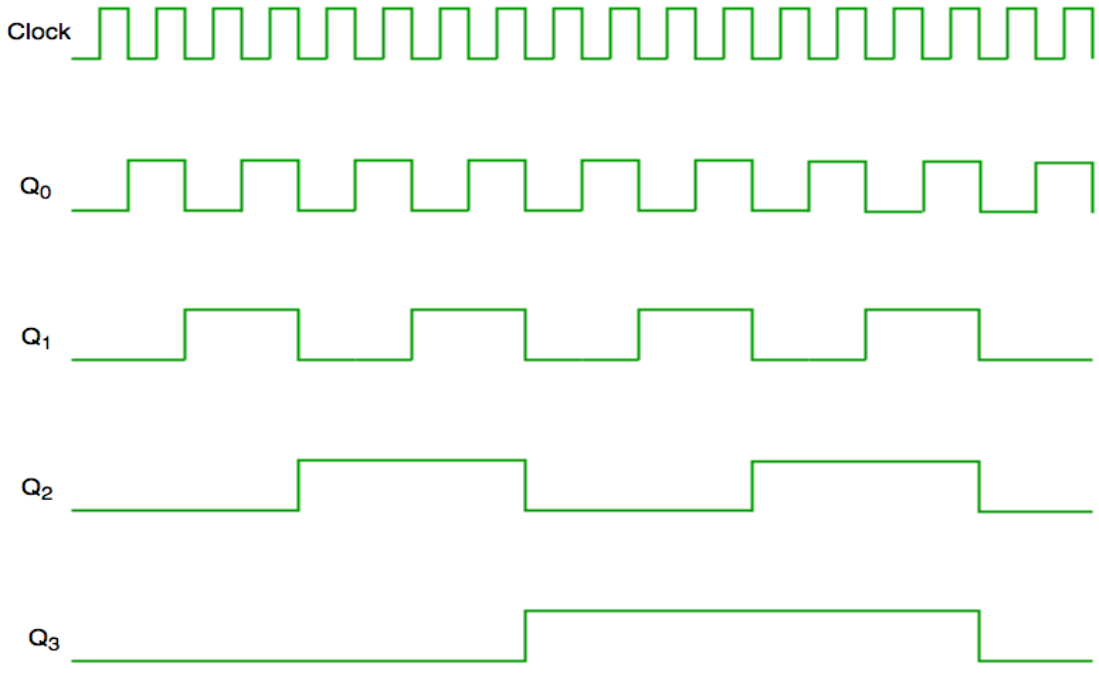
Asynchronous Counter:

In asynchronous counter we don't use universal clock, only first flip flop is driven by main clock and the clock input of rest of the following flip flop is driven by output of previous flip flops. We can understand it by following diagram-

LOGIC DIAGRAM FOR 4 BIT RIPPLE COUNTER:



(a) Asynchronous counter



(b) Timing Diagram

It is evident from timing diagram that Q0 is changing as soon as the rising edge of clock pulse is encountered, Q1 is changing when rising edge of Q0 is encountered(because Q0 is like clock pulse for second flip flop) and so on. In this way ripples are generated through Q0,Q1,Q2,Q3 hence it is also called RIPPLE counter.

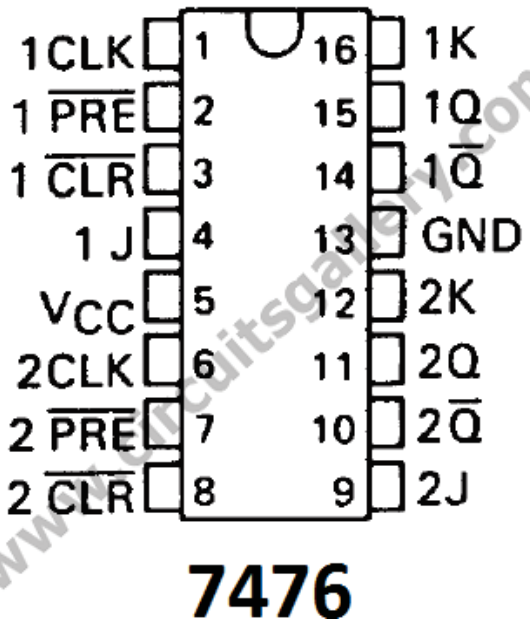
TRUTH TABLE:

CLK	Q0	Q1	Q2	Q3
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

Synchronous Counter:

Unlike the asynchronous counter, synchronous counter has one global clock which drives each flip flop so output changes in parallel. The one advantage of synchronous counter over asynchronous counter is, it can operate on higher frequency than asynchronous counter as it does not have cumulative delay because of same clock is given to each flip flop.

PIN DIAGRAM FOR IC 7476:



Modulus 10 Counter:

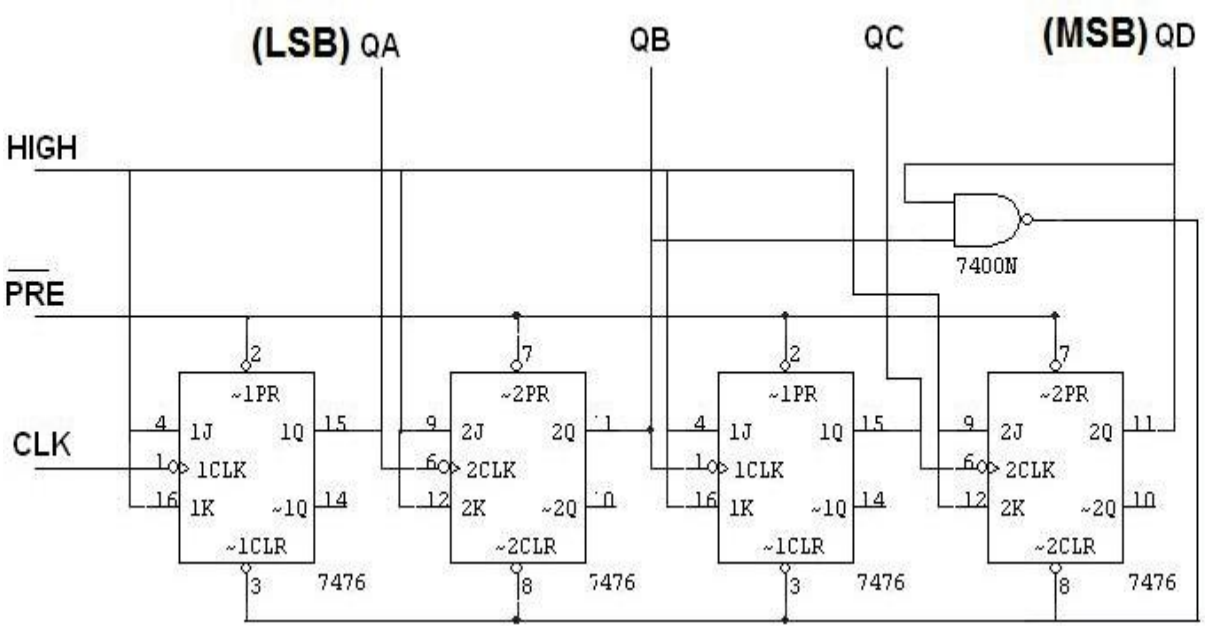
A good example of a modulo-m counter circuit which uses external combinational circuits to produce a counter with a modulus of 10 is the

Decade Counter. Decade (divide-by-10) counters such as the TTL 74LS90, have 10 states in its counting sequence making it suitable for human interfacing where a digital display is required.

The decade counter has four outputs producing a 4-bit binary number and by using external AND and OR gates we can detect the occurrence of the 9th counting state to reset the counter back to zero. As with other mod counters, it receives an input clock pulse, one by one, and counts up from 0 to 9 repeatedly.

Once it reaches the count 9 (1001 in binary), the counter goes back to 0000 instead of continuing on to 1010. The basic circuit of a decade counter can be made from JK flip-flops (TTL 74LS73) that switch state on the negative trailing-edge of the clock signal as shown.

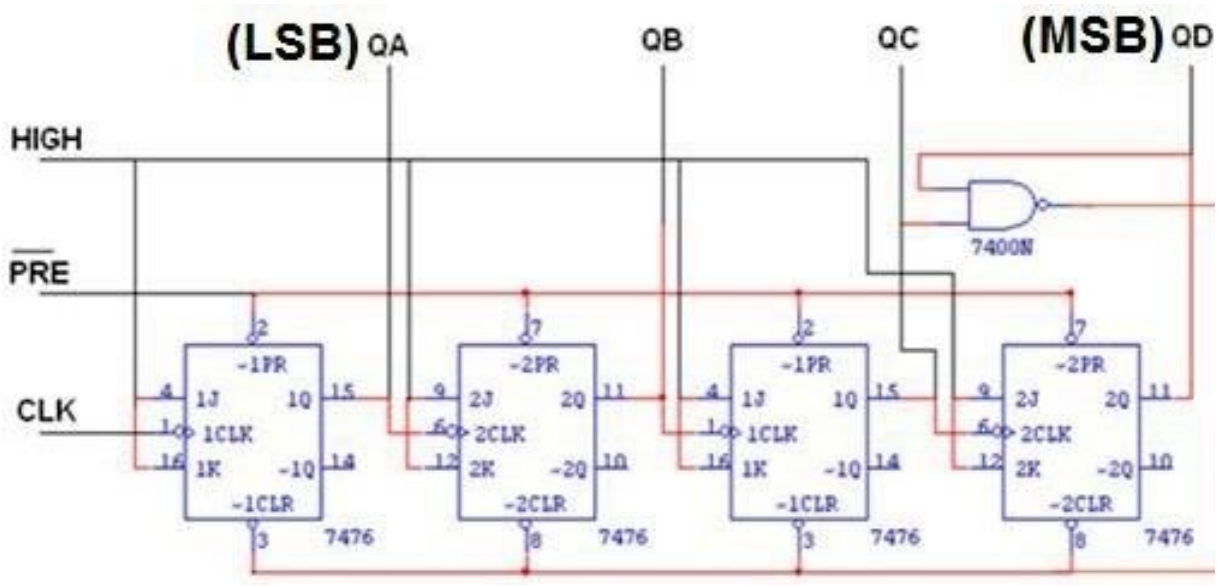
LOGIC DIAGRAM FOR MOD-10 RIPPLE COUNTER:



TRUTH TABLE:

CLK	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	0	0	0

LOGIC DIAGRAM FOR MOD-12 RIPPLE COUNTER:



TRUTH TABLE:

CLK	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	0	0

PROCEDURE:

1. Connections are given as per circuit diagram.
2. Logical inputs are given as per circuit diagram.
3. Observe the output and verify the truth table.

PRECAUTION:

1. All the ICs should be checked before using the apparatus.
2. All LEDs should be checked.
3. All connections should be tight.
4. Always connect GROUND first and then VCC.
5. The circuit should be off before changing the connections.
6. After completing the experiment switch off the supply to apparatus.

CONCLUSION:

Thus the ripple counters are studied. We can create 4 bit ripple counter and mod 10, mod 12 counter by using logic gates and flip flop. We also verify the truth table of these counters.

REVIEW QUESTIONS:

1. Counters can be used as frequency dividers. When the clock frequency in the 4-bit Ripple Counter given above is 1 kHz, what will be the output frequency of Flip-Flop A and Flip-Flop B?

   f_A= 500 Hz

   f_B= 25 Hz

2. Would inverters on the clock inputs change the count direction of a Ripple Counter?

ANS:

Would inverters on the clock inputs change the count direction of a Ripple Counter is same because the flip flop toggle the positive age of the clock and the negative age of the clock is no change in the flip flop thus we can inverters the clock input the count direction is not change.

3. How many Flip-Flops are needed to build a MOD-5 Counter?

ANS:

We need for 5 is 3 bit so we need the three flip flop to build a mod-5 counter.