Indian Institute of Technology Ropar

Department of Electrical Engineering

EE204 : Digital Circuits Laboratory

Classroom - Analog and Digital Circuits Lab

Introduction:

Counters are specially designed synchronous sequential circuits, in which the state of the counter is equal to the count held in the circuit by the flip flops. Counters calculate or note down the number that how many times an event occurred. Counters are the crucial hardware components, and are defined as “The digital circuit which is used to count the number of pulses''. Counters are well known to us as “Timers''. Counter circuits are the best example for the flip flop applications. Counters are designed by grouping of flip flops and applying a single clock signal to them. In simple words, the counters are those, which have the group of storage elements like flip flops to hold the count. Counters have modes. The ‘mod’ of the counter represents the number of states of the cycles through it, before setting the counter to its initial state. For example, a binary mod 8 counter has 8 countable states. They are from 000 to 111. So the mod 8 counter counts from 0 to 7.

Aim:

Study of Synchronous and Asynchronous Counters

Theory:

A counter is a circuit consisting of a number of Flip Flop and gates working together to count the number of clock pulses applied to its input. There are numerous types of counters, and we cannot look at them in this experiment. The basic binary counter is probably the simplest to construct and form the basis for more advanced types of counters. In this experiment, we look at some of the counter circuits found most often and give you an opportunity to connect and observe them.

Pre-Lab quiz:

Q. What is the counter? How are the Synchronous and Asynchronous Counters different?

Q. Evaluate the truth table, Boolean function, and gate-level circuit for the objective II.

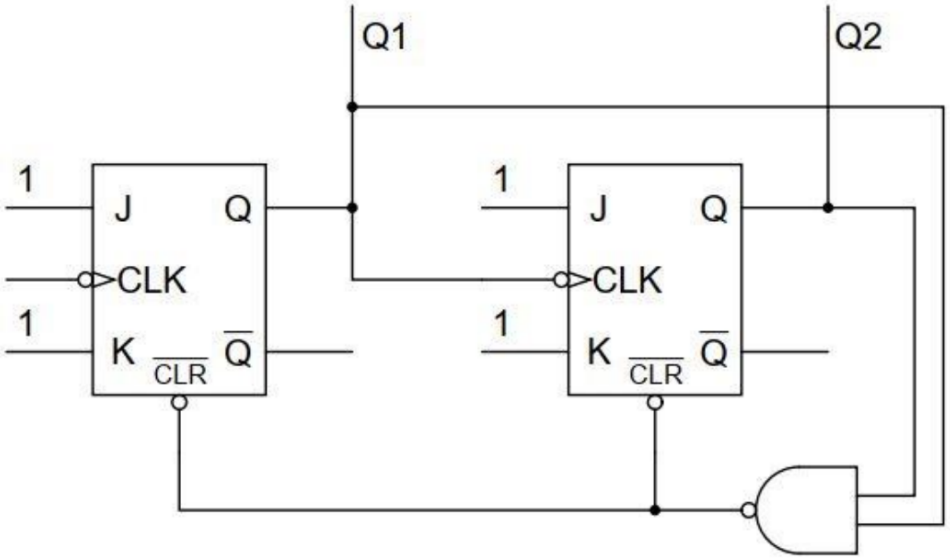
Components:

TTL ICs 74LS00, 74LS10, 7473IC, and clock generator kit.

Objective:

The objective of this lab exercise is to realise the Synchronous and Asynchronous Counters using J-K flip-flop. In this lab exercise, we will design and implement the following arithmetic operation.

I. Connect the circuit for a mod-3 counter as shown in the figure. Is this a synchronous, or an asynchronous counter? Display the Q1 and Q2 waveforms on a CRO and verify the functioning of the circuit.



II. Design a mod-5 synchronous counter in the following manner.
   A. First make a state table specifying the current state and the next state.
   B. Some of the states can be don't care (5, 6, 7).
   C. Calculate the number of flip-flops you need.
   D. Next, assign values to the inputs of all the flip-flops.
   E. Using Karnaugh-maps, evaluate the logical expressions for the inputs of the different flip-flops.
   F. Make the circuit using flip-flops, and logic gates.

Post-Lab quiz:

Q. Extend this lab exercise to implement an UP/DOWN decade counter?

Q. Can we use mod-n counters as a frequency divider circuit? How?

Suggested Readings: M. Morris Mano, "Digital Logic and Computer Design", Pearson Prentice Hall, 2008.