# Lab #5: Counters

In this lab you are required to handle the multiple different counters.

1. Use 25MHz clock to generate such counters.
2. Divide the frequency by 1M (220)) to get a frequency of about 25Hz.
3. Use this clock to generate the following two counters.

## Johnson Counter

Johnson Counter is a counter that produces four-bit count. The counter is obtained by shifting the bits to the left. Incoming bit is obtained by inverting the outgoing most significant bit. For example, it would generate the following sequence of outputs.

4’b0000 🡪‘4’b0001 🡪 4’b0011 🡪 4’b0111🡪 ‘4b1111 🡪 4’b1110 🡪 4’b1100 -> 4’b1000 🡪4’b0000 …

Or in Hex

‘h0 🡪 ’h1 🡪 ‘h3 🡪 ‘h7 🡪 ‘hF 🡪 ‘hE 🡪 ‘hC 🡪 ‘h8 🡪 ‘h0 🡪 ….

Show the counter value on the seven segment display where the display values would scroll as follows.

bbb0 🡪 bb01 🡪 b013 🡪 0137 🡪 137F 🡪 37FE 🡪 ….

In other words, the display would be scrolling left showing upto three past counter values.

## Clock

Clock counter is he cone that has three counters. Hours/Minute and Seconds. At each one second, the second counter is incremented by 1. As soon as it reaches 60, it is reset back to 0 and the minute counter is incremented. When the minute counter reaches 60, it is reset back to zero and hours counter is incremented. When hours counter reaches 24, it is reset to 0.

You will need to display the clock counters on the 7-segment display where first two digits will show the hour while the last two digits will show the minutes.

Two sets of digits will be separated by two DP LEDs which shall blink at each second. (Will be ON for half second and OFF for half second).

You will notice that the DP LED is mounted so that the two DP LEDs appear like a colon on the display.

You will need to divide the 25Hz clock by 12 (or whatever count needed) to get 2Hz signal. At each clock edge of this you will need to toggle the DP LEDs.