

## Lab 4: Counters and Shift Registers II

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### Objective

- ✓ Review sequential circuits.
- ✓ Review counters and shift registers.

### Prerequisite

- ✓ Fundamentals of logic gates.
- ✓ Clocking concepts
- ✓ Logic modeling in Verilog HDL.

### Experiments

- 1 Construct a 4-bit synchronous binary up counter ( $b_3b_2b_1b_0$ ) with the 1-Hz clock frequency from lab2 and use 4 LEDs for display.

I/O	$f_{crystal}$	$b_3$	$b_2$	$b_1$	$b_0$
Site	W5	V19	U19	E19	U16

- 2 Combine the 4-bit synchronous binary up counter from exp1 with a binary-to-seven-segment-display decoder (from lab2-exp3) to display the binary counting in 7-segment display.
- 3 Construct a single digit BCD up counter with the divided clock as the clock frequency and display on the seven-segment display.
  - 3.1 Construct a BCD up counter.
  - 3.2 Construct a BCD-to-seven-segment display decoder (from lab2-exp2).
  - 3.3 Combine the above two together.
- 4 Construct a single digit BCD down counter with the divided clock as the clock frequency and display on the seven-segment display.
  - 4.1 Construct a BCD up counter.
  - 4.2 Construct a BCD-to-seven-segment display decoder (from lab2-exp2).
  - 4.3 Combine the above two together.
- 5 (Bonus) Construct a 30-second count down timer (stop at 00).