

## ECEN 4856 Laboratory Exercise 3

The lab contains five (5) parts, many parts building on the knowledge gained from the prior components. Please read the directions carefully and:

1. Create a new project which will be used to implement the desired circuit on the DE2 board.
2. Write a VHDL file that specifies the desired circuit.
3. Include the VHDL file in your project and compile the circuit.
4. Assign the pins on the FPGA to connect to the 7-segment displays, the pushbutton switch, etc. as needed to complete the design.
5. Recompile the circuit and download it into the FPGA chip.
6. Verify that your circuit works correctly by observing the display, toggling switches, etc.

A team lab report is to be submitted providing well documented code with a brief explanation of your work on each part (a few sentences). Reports are due Thursday October 9<sup>th</sup>.

### Part I

We wish to display the hexadecimal value of a 16-bit number A on the four 7-segment displays, HEX<sub>7-4</sub>, we also wish to display the hex value of a 16-bit number B on the four 7-segment displays, HEX<sub>3-0</sub>. The values of A and B are inputs to the circuit which are provided by means of switches SW<sub>15-0</sub>. This is to be done by first setting the switches to the value of A and then setting the switches to the value of B; therefore, the value of A must be stored in the circuit.

### Part II

Design and implement a circuit that successively flashes digits 0 through 9 on the 7-segment display HEX<sub>0</sub>. Each digit should be displayed for one second. Use a counter to determine the one-second intervals. The counter should be incremented by the 50-MHz clock signal provided on the board.

### Part III

Design and implement a circuit that displays the word HELLO, in ticker tape fashion, on the eight 7-segment displays HEX<sub>7-0</sub>. Make the letters move from right to left in intervals of one second.

### Part IV

Implement a 3-digit BCD counter. Display the contents of the counter on the 7-segment displays, HEX<sub>2-0</sub>. Derive a control signal, from the 50-MHz clock signal provided on the Altera DE2 board, to increment the contents of the counter at one-second intervals. Use the pushbutton switch KEY<sub>0</sub> to reset the counter to 0.

### Part V

Design and implement a circuit that acts as a time-of-day clock. It should display the hour (from 0 to 23) on the 7-segment displays HEX<sub>7-6</sub>, the minute (from 0 to 60) on HEX<sub>5-4</sub> and the second (from 0 to 60) on HEX<sub>3-2</sub>. Use the switches SW<sub>15-0</sub> to preset the hour and minute parts of the time displayed by the clock.