Lab 4 – Worksheet

Part I:

1. Design a 1 bit full adder with inputs: A, B, and C_{in}; and outputs S and C_{out}.
2. Draw the truth table for your full adder.
3. Use a K-map, simplify and draw the resultant circuit.
4. Create a VHDL model of your testbench using simple gates (e.g., and, or, not, xor, etc.)
5. Create a VHDL testbench to verify your truth table.
6. Demonstrate the simulation of your testbench to the TA.

Part II:

1. Design a 4 bit twos-complement adder/subtracter using your full adder and simple gates.
2. The circuit should have two 4 bit inputs A(3 downto 0), B(3 downto 0) and a single bit to select addition or subtraction.
3. The circuit should also produce one output S(3 downto 0).
4. Draw a schematic and write VHDL.
5. Design a circuit to detect overflow and signal when overflow has occurred. (e.g., there should be a single bit output overflow that indicates overflow as occurred.) Write VHDL for the overflow as well.
6. Create a VHDL testbench to test at least 2 additions and one subtraction.
7. Demonstrate the simulation of your testbench to the TA.

Part III:

1. Next we will use our adder/subtracter in a simple ALU (Arithmetic Logic Unit).
2. Use your 4 to 1 mux select from the output of four different ALU operations:
   (a) The adder/subtracter
   (b) a AND b
   (c) a OR b
   (d) a and /not b

3. This simple ALU will have 5 inputs: Mux selects s0,s1; a(3..0) and b(3..0); and sub (setting add or subtract.)

4. The outputs will be 4 bits s(3..0) and overflow.

5. Draw the schematic and write VHDL.

6. Write a VHDL testbench testing all four separate operations.

7. Demonstrate the simulation of your testbench to the TA.

8. Take the DXCRP-lab4.zip design and open the lab4 ise project.

9. You will need to make sure you are targeting the correct device, an XPLA 3 CoolRunner XC3064, and will probably have to add all of the input files.

10. Insert your simple alu VHDL component into xrcpdemo.vhd and connect to the provided wires. There is a seven-segment display driver provided as well as all of the inputs are connected. You should only need to connect your ALU and overflow detection circuits to to the provided signals.

11. Download your design onto the board.

12. Demonstrate the proper execution of your design on the board to the TA.