Professor Fearing   EECS150/Problem Set 1   Fall 2013

Due at 10 am, Thu. Sep. 12 (location tbd)

Reading Harris and Harris: 1.1-1.6, 2.1-2.6, 4.1-4.3, 4.5, 4.8

1. (10 pts) Perform the following number system conversions (assume unsigned binary):

a. $0010\ 0011\ 1001_2\ =\ ?_8\ =\ ?_{10}\ =?_{16}$ b. $111.1001_2\ =?_8\ =?_{10}\ =?_{16}$

c. $?_2\ =?_8\ =?_{10}\ =\ 1A0_{16}$ d. $?_2\ =?_8\ =?_{10}\ =\ 3.133_{16}$

e. $?_2\ =?_8\ =\ 232.5_{10}\ =?_{16}$

2. (15 pts) Arithmetic:

a. Showing your calculations, add 108_{10} and 117_{10} in base 2, 10, and sixteen.

b. Showing your calculations, multiply 123_4 and 231_4 in base 2, 10, and sixteen.

c. Showing your calculations, use long division to find $1110\ 0010_2$ divided by 1001_2.

3. (15 pts) DC Transfer Characteristics

Harris & Harris exercise 1.78.

4. (10 pts) 2-input Mux

Using a minimum number of 2:1 muxes, draw a diagram showing designs for NOT, and 2-input AND, OR, and XOR functions. You may use static inputs "0" and "1" to the muxes in addition to the function inputs.

5. (10 pts) Look-up Tables

You are given a look-up table (LUT) with 2 binary adresses and one input. Show how these 2 input LUTs can be combined to perform ANY 4 input logic function.

6. (10 pts) Boolean algebra

Reduce the following Boolean expressions using theorems and identities and express in Sum-of-Products form (luckily now done by synthesis tools):

a. $F = \overline{A\overline{(B + \overline{C})}D}$

b. $F = \overline{A \cdot \overline{B} \cdot \overline{C}}$

c. $F = (A + \bar{B})(\bar{A} + B + C)(\bar{A} + B + \bar{C})$

7. (15 pts) Verilog

Write a Verilog module (with correct syntax) called `majority`. It receives three inputs `a, b,` and `c`. It produces one output `y` which is TRUE if 2 or more of the inputs are TRUE.

8. (15 pts) Verilog

Write a Verilog module (with correct syntax) called `PriorityEncoder` with 8 inputs `A[7:0]`, 3 bit output `Y[2:0]`, and binary output `None`. `Y` encodes the most significant "1" input bit in `A`. Output `None` is TRUE if all inputs `A[7:0]` are "0". For example if `A = 0110 1111`$_2$ then `Y = 110`$_2$. (This is a priority encoder.)