Professor Fearing EECS150/Problem Set 1 Fall 2003

Due at 10 am, Fri. Sep. 5 in box outside 125 Cory Hall

Reading Ciletti: App. A, 2.1-2.3, 3.2

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

a. $1011\ 0101_2 = ?_8 = ?_{10} = ?_{16}$ b. $100.1001_2 = ?_8 = ?_{10} = ?_{16}$

c. $?_2 = ?_8 = ?_{10} = 150_{16}$ d. $?_2 = ?_8 = ?_{10} = 3.244_{16}$

e. $?_2 = ?_8 = 247_{10} = ?_{16}$

2. (10 pts) Arithmetic:

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

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

3. (10 pts) Modulo arithmetic. Calculate the following:

a. $150_{10} \pmod 8 = ?_{10}$ b. $150_{10} \pmod 4 = ?_{10}$

c. Does $x \pmod 2$ plus $y \pmod 2$ equal $(x+y) \pmod 2$?

4. (15 pts) Reduce the following Boolean expressions using theorems and identities:

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

b. $F = AB + BC\bar{D} + \bar{A}C\bar{D}$

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

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

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

5. (20 pts) Implement $F = A\bar{B} + C\bar{D}$ with:

a. AND, OR, and NOT gates.

b. only NAND gates

c. only NOR gates

(See fig. 2-50, 2-51 in Ciletti for alternative symbols, which should help in thinking about implementation).

6. (20 pts) Logic Design.

a. Write the truth table for an arithmetic function block with two inputs A_0 and B_0, two output bits D_1 and D_0, and a control input C. When C is true, the output should be the product $A_0 \times B_0$ and when C is false, the output should be the sum A_0 plus B_0.

b. Write the logic equations for D_1 and D_0.

c. Using asserted high inputs and outputs, design logic for D_1 and D_0 using AND, OR, and NOT gates.

7. (15 pts) CMOS.

Draw its common symbol or state the equivalent Boolean expression for the following: