Professor Fearing EECS150/Problem Set 1 Fall 1999

Due at 10 am, Fri. Sep. 3 in box outside 218 Cory Hall

Reading Katz: App. A, 5.1, Ch. 1, 2:2.2, 2.5, 3.1.1

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

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

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 $F.H = A\bar{B} + C\bar{D}$ with inputs A and B asserted low, and C and D asserted high (i.e. inputs are $A.L, B.L, C.H, D.H$) using:

a. AND, OR, and NOT gates.

b. only NAND gates

c. only NOR gates

(See fig. 2.60 in Katz for alternative symbols for gates, 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) Timing.

Assuming unit delay for the NOT and AND gate, sketch a timing diagram showing $A, A1, Y$. Assume A is zero for 4 time units, goes to 1 for 4 time units and then returns to zero for 4 time units.