Professor Fearing **EECS 150/Problem Set 1** **Fall 1997**

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Problem 1 (15 pts)

a. $1011001_2 = 131_8 = 59_{16} = 1_{10} + 8_{10} + 16_{10} + 64_{10} = 89_{10}$

b. $11.11_2 = 3.6_8 = 3.75_{10} = 3.C_{16}$

c. Conversion from decimal to binary :

$105/2 = 52$ remainder 1
$52/2 = 26$ remainder 0
$26/2 = 13$ remainder 0
$13/2 = 6$ remainder 1
$6/2 = 3$ remainder 0
$3/2 = 1$ remainder 1 $\Rightarrow$ $105_{10} = 1101001_2 = 105_{10} = 69_{16} = 151_8$

d. $8A.F_{16} = 10001010.1111_2 = 138.9375_{10} = 212.74_8$

e. $216_{16} = 1000010110_2 = 1026_8 = 512_{10} + 16_{10} + 6_{10} = 534_{10}$

Problem 2 (10 pts)

a. Conversion : $108_{10} = 1101100_2 = 6C_{16}$ $117_{10} = 1110101_2 = 75_{16}$

$$\begin{array}{rccc} & 1 & 0 & 8 \\ + & 1 & 1 & 7 \\ \text{carry:} & 0 & 1 & \\ \hline \text{sum:} & 2 & 2 & 5 \end{array} \qquad \begin{array}{rcccccccc} & & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ & + & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ \text{carry:} & 1 & 1 & 1 & 1 & 1 & 0 & 0 & \\ \hline \text{sum:} & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{array} \qquad \begin{array}{rcc} & 6 & C \\ + & 7 & 5 \\ \text{carry:} & 1 & \\ \hline \text{sum:} & E & 1 \end{array}$$

b. Conversion : $113_4 = 10111_2 = 23_{10} = 17_{16}$ $23_4 = 1011_2 = 11_{10} = B_{16}$

$$\begin{array}{rccc} & & 2 & 3 \\ \times & & 1 & 1 \\ \hline & & 2 & 3 \\ & 2 & 3 & \\ \text{carry:} & 0 & 0 & 0 \\ \hline \text{sum:} & 2 & 5 & 3 \end{array} \qquad \begin{array}{rcccccccc} & & & & 1 & 0 & 1 & 1 & 1 \\ \times & & & & & 1 & 0 & 1 & 1 \\ \hline & & & & 1 & 0 & 1 & 1 & 1 \\ & & & 1 & 0 & 1 & 1 & 1 & \\ & 1 & 0 & 1 & 1 & 1 & & & \\ \text{carry:} & 0 & 1 & 1 & 1 & 1 & 1 & 0 & \\ \hline \text{sum:} & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 \end{array} \qquad \begin{array}{rcc} & 1 & 7 \\ \times & & B \\ \hline & F & D \end{array}$$

Problem 3 (15 pts)

a. $155_{10}/8 = 19_{10}$ remainder 3 $\Rightarrow$ $155_{10}(\text{mod } 8) = 3_{10}$

b. $155_{10}/4 = 38_{10}$ remainder 3 $\Rightarrow$ $155_{10}(\text{mod } 4) = 3_{10}$

c. NO. Example : $21_{10}(\text{mod } 8) + 39_{10}(\text{mod } 8) = 5_{10} + 7_{10} = 12_{10}$
while $60_{10}(\text{mod } 8) = 4_{10} \neq 12_{10}$

Problem 4 (20 pts)

Numbers above equate signs represent rule applied (page 51 of the text)

a. $F = AB(C + \overline{C}) + A\overline{B} \overset{5.}{=} AB(1) + A\overline{B} \overset{1D.}{=} AB + A\overline{B} \overset{8.}{=} A(B + \overline{B}) \overset{5.}{=} A(1) \overset{1D.}{=} \underline{\underline{A}}$

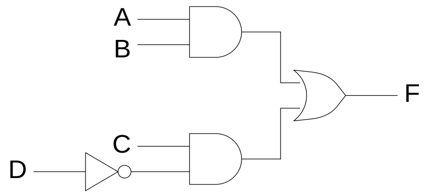
b. $F = A\overline{B} + A\overline{C} + \bar{B}\bar{B} \overset{3D.}{=} A\overline{B} + A\overline{C} + \overline{B} \overset{8.}{=} \overline{B}(A + 1) + A\overline{C} \overset{2.}{=} \overline{B}(1) + A\overline{C}$
$\overset{1D.}{=} \underline{\underline{\overline{B} + A\overline{C}}}$

c. $F = \overline{A(\overline{B + C})D} \overset{12.}{=} \overline{A\bar{B}\bar{C}D} \overset{12D.}{=} \underline{\underline{\overline{A} + B + C + \overline{D}}}$

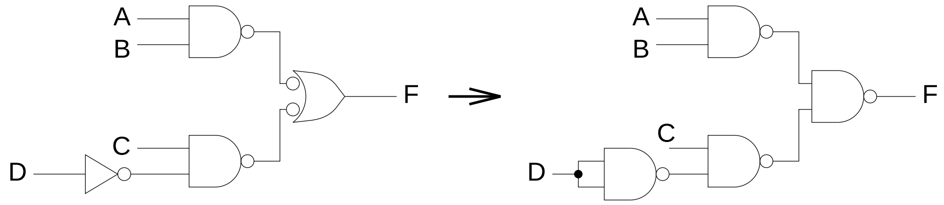
d. $F = \overline{A\bar{B}\bar{C}} \overset{12D.}{=} \underline{\underline{\overline{A} + B + C}}$

Problem 5 (20 pts)

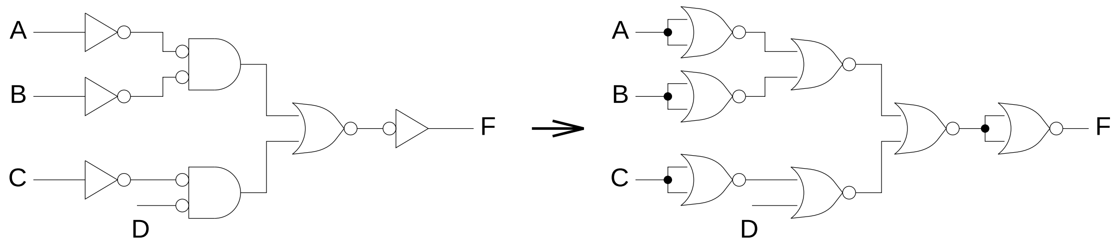
a.



b.



c.



Problem 6 (20 pts)

a.

A	B	BorrowIn	D	BorrowOut
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

b. $D = \mathrm{BorrowIn}\bar{A}\bar{B} + \overline{\mathrm{BorrowIn}}\bar{A}B + \overline{\mathrm{BorrowIn}}A\bar{B} + \mathrm{BorrowIn}AB$
$\mathrm{BorrowOut} = \overline{A}(B + \mathrm{BorrowIn}) + AB\mathrm{BorrowIn}$

c.