CED 4260 IC Design and Fabrication

Assignment #4 solution
Http://myweb.dal.ca/~jgu/4260/assignments.html

Assignment #4 contains the following problems:

1) Convert the following binary numbers to decimal numbers; using each of unsigned, sign and magnitude, one's complement, and two's complement representation.
   011011, 1010101, 10100011110000

   If unsigned: 27, 85, 10480.
   If sign & magnitude: 27, -21, -2288
   If one's complement: 27, -42, -5903
   If two's complement: 27, -43, -5904

2) Convert the following decimal numbers into two's complement representation binary numbers –1023, 1998, 88888, -9999

   10000000001, 011111001110, 010101101100111000, 101100011110001.

3) Calculate the worst-case delay of a 6-bit adder built with a two 3-bit carry look-ahead adders and a carry look-ahead generator.
   3 gate delays: a0 --- g0-2
   2 gate delays: g0-2 ---c3
   2 gate delays: c3 --- c5
   3 gate delays: c5 --- s5
   total gate delays 10
4) Multiply the following numbers using Booth multiplication and fast (modified booth) multiplication. Show all partial products:

   10100101110, 11000101110

   010100100010010001000100

5) For each pair of IEEE 754 single precision floating point numbers, find their sum and product expressed in IEEE 754 using the algorithms shown in class. Express the given numbers in decimal as well:

   Solution:

   A)
   $a=-1.1*2^{(128-127)}=-1.1*2=-11_2=-3_{10}=-0.11*2^2$
   $b= 1.11*2^{(129-127)}=1.11*2^2=-111_2=7_{10}=1.11*2^2$

$sum(a,b)=1.00*2^{2}$
$prod(a,b)=-1.1*1.11*2^{(1+2)}=-10.101*2^{3}=-1.0101*2^{4}$

Sum(a,b)	**0**	**10000001**	**00000000000000000000000**
prod(a,b)	**1**	**10000011**	**01010000000000000000000**

B)

$a=1.0101*2^{(96-127)}=1.0101*2^{-31}=6.1118*10^{-10}{}_{10}$
$b=1.01011*2^{(96-127)}=1.01011*2^{-31}=6.2573*10^{-10}{}_{10}$
$sum(a,b)=10.10101*2^{-31}=1.010101*2^{-30}$
$prod(a,b)=1.110000111*2^{(-31+-31)}=1.110000111*2^{-62}$

Sum(a,b)	**0**	**01100001**	**01010100000000000000000**
prod(a,b)	**0**	**01000001**	**11000011100000000000000**

A)

1	**10000000**	**10000000000000000000000**
0	**10000001**	**11000000000000000000000**

B)

0	**01100000**	**01010000000000000000000**
0	**01100000**	**01011000000000000000000**