**CS375 Digital Systems Sample Test**

1. Simplify two of the three following algebraic expressions using theorems from Boolean algebra. Show each transformation and cite the theorem that provides it.

a.)

ab’ + a(b+c)’ + b(b+c)’

*b.)*

x2x3’x4’+x2x3’x4+x1x2’x3’

1. Consider the function f(x1, x2, x3) = ∑m(0, 1,3,4,5,6)

Write the resulting sum of products and the equivalent product of sums. Draw a circuit for each using only nand gates or only nor gates.

1. Draw a Karnaugh map for the function in question #2. Identify the prime implicants and essential prime implicants. Write the resulting equation. Repeat the procedure for the product of sums.
2. Use Venn diagrams to show that the SOP and POS from question 3 are equivalent.
3. Draw the Karnaugh map, identify prime and essential prime implicants, and produce the resulting algebraic expression for the function f(x1,x2,x3,x4,x5) = ∑m(0, 3,5,6,7,14,16,19,21,22,31)
4. Write the 8-bit binary representations for the following numbers in the encoding scheme specified:
   1. 33 (2’s complement)
   2. -43 (1’s complement)
   3. -43 (2’s complement)
5. Explain why it is always possible to implement a SOP expression using only NAND gates.
6. Explain the differences in a ripple-carry adder and a carry-lookahead adder.
7. Show how you can implement a 4x16 decoder using 2x4 decoders.
8. Use Shannon’s Expansion Theorem to implement the following function using a 2x1 multiplexer and some additional logic for the inputs.
   1. abc' +a’bc