CSE140 Exercise on April 16, 2009

(I) (Laws and Theorems of Boolean Algebra) Prove using Boolean algebra that $a'c' + ab + ac + a'b' = a'c' + ab + b'c$. Write the particular law you are using in each step.

(II) (Laws and Theorems of Boolean Algebra) Prove using Boolean algebra that $(a + c)(a' + c')(b' + c + d')(a + b' + d') = (a + c)(a' + c')(b' + d')$. Write the particular law you are using in each step.

(III) (Karnaugh Map) Use Karnaugh map to simplify function $f(a, b, c, d) = \sum m(0,1,2,3,4,5,7,8,12) + \sum d(10,11)$. List **all possible** minimal two-level **sum of products** expressions. Show the switching functions. No need for the diagram.

(IV) (Karnaugh Map) Use Karnaugh map to simplify function $f(a, b, c, d) = \sum m(0,1,2,3,4,5,7,8,12) + \sum d(10,11)$. List **all possible** minimal two-level **product of sums** expressions. Show the switching functions. No need for the diagram.

(V) Universal Set of Gates: Check if the set in the following list is universal and explain your decision. Assuming constants 0 and 1 are available as inputs.

i. {AND, NOT}

ii. {NAND}

iii. {XOR, NOT}

iv. $\{f(x, y)\}$, where $f(x, y) = x'y$

v. $\{g(x, y, z)\}$, where $g(x, y, z) = (x + y)z'$

vi. $\{f(x, y), g(x, y)\}$, where $f(x, y) = x'y + xy'$ and $g(x, y) = x'y'$