COMP 249 Logic Circuits

Due: 12-October-2009

Monday 09:00

Assignment 2

1. Using the properties of a general Boolean Algebra (whose elements are not only 0 and 1), reduce the following expressions into a minimum sum of products form:
   (a) $x'y'z' + x'y'z + x'yz + xy'z + xyz + xyz'$
   (b) $a'b'c' + a'bc' + a'bc + ab'c + abc' + abc$
2. Consider a Boolean algebra with $S = \{0, 1\}$. Let $f : S^3 \longrightarrow S$ whose values are given as $f(i) = 0$ for $i = 1, 2, 5, 7$ and $f(i) = 1$ for $i = 0, 3, 4, 6$.
   (a) Derive the Boolean function in sum of minterms canonical form.
   (b) Derive the Boolean function in product of maxterms canonical form.
   (c) Derive the Boolean function in Reed-Muller canonical form.
3. Show a block diagram of a system using AND, OR, and NOT gates to implement the following function. Assume that the variables are only uncomplemented. Do not manipulate the algebra.
$$F = (A(B + C)' + BDE)(A' + CE)$$
4. Show a block diagram corresponding to the following expression using only NAND gates. Assume all inputs are available both uncomplemented and complemented. There might be a need to manipulate the function to simplify the algebra.
$$f = b(c'd + c'e') + (a + ce)(a' + b'd')$$
5. Show a block diagram corresponding to the following expression using only NOR gates. Assume all inputs are available both uncomplemented and complemented. There might be a need to manipulate the function to simplify the algebra.
$$g = \{a'b' + a(c + d)\}(b + d')$$
6. A minority function has an output value of 1 if there are less 1's than 0's on its inputs. The output is 0 otherwise. Consider the design of the four input minority function.
   (a) Tabulate the truth table for the four input minority function.
   (b) Derive the output Boolean function in sum of minterms form (SOM) and product of maxterms (POM) form.
   (c) Optimize the output Boolean function in sum of products form (SOP) and product of sums form (POS) using the axioms of a general Boolean Algebra.