COMP 249 Logic Circuits

Due: 26-October-2009

Monday 23:55

Assignment 3

1. For each of the following functions, find all prime implicants using the Quine-McCluskey method:
   (a) $f(a, b, c) = \Sigma m(1, 2, 3, 6, 7)$
   (b) $g(w, x, y, z) = \Sigma m(2, 3, 6, 7, 8, 10, 11, 12, 13, 15)$
   (c) $h(p, q, r, s) = \Sigma m(5, 7, 9, 11, 13, 14)$, $\Sigma d(2, 6, 10, 12, 15)$
2. Consider the Boolean functions given in Problem 1, and using Quine-McCluskey method, minimize each function in
   (a) Sum of Products (SOP) form
   (b) Product of Sums (POS) form
3. Consider the following Boolean functions:
   (a) $F(A, B, C, D) = AD + AB + A'CD' + B'CD + A'BC'D'$
   (b) $g(w, x, y, z) = (w + y' + z')(x' + y + z')(w' + y')(w' + x' + y + z)(w' + z')(x' + y' + z)$

   Using Karnaugh method, minimize these Boolean functions in both sum of products (SOP) form and product of sums (POS) form.
4. Design a circuit with output f and inputs x_1, x_0, y_1, and y_0. Let $X = x_1x_0$ be a number, where the possible values of X, namely, 00, 01, 10, and 11, represent the four numbers 0, 1, 2, and 3, respectively. Similarly, let $Y = y_1y_0$ represent another number with four possible values. The output f should be 1 if the numbers represented by X and Y are equal. Otherwise, f should be 0.
   (a) Show the truth table for f.
   (b) Using the Quine-McCluskey method, sythesize the simplest possible product of sums (POS) expression for f.
   (c) Using Karnaugh method, optimize the Boolean function in sum of products form (SOP).
   (d) Draw the logic circuit implementation of the Boolean function as a two-level NOR circuit and a two-level NAND circuit.