Cpr E 281 HW05
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Karnaugh Maps
Assigned Date: Fifth Week
Due Date: Oct. 2, 2017

P1. (15 points) Find the simplified Boolean expression for the following functions using a K-map.

(a) F(A, B, C) = Σm(1, 3, 5) + d(6, 7)
(b) F(A, B, C) = Σm(0, 1, 3, 7) + d(2, 5)
(c) F(A, B, C, D) = Σm(1, 3, 7, 11, 15) + d(0, 2, 4)
(d) F(A, B, C, D) = Σm(5, 6, 7, 12, 13) + d(4, 9, 14, 15)
(e) F(W, X, Y, Z) = Σm(0, 7, 8, 9, 10, 12) + d(2, 5, 13)

P2. (15 points) Find the simplified Boolean expression for the following POS functions using a K-map.

(a) F = (A + B + C') (A + B' + C') (A' + B' + C') (A' + B + C) (A + B + C)
(b) F = (A' + B' + C + D) (A' + B' + C' + D) (A' + B' + C' + D') (A' + B + C + D) (A + B' + C' + D) (A + B' + C' + D') (A + B + C + D) (A' + B' + C + D')
(c) F(A, B, C) = $\Pi M(0,2,4,5)$
(d) F(A, B, C) = $\Pi M(1,3,5,7)$
(e) F(A, B, C, D) = $\Pi M(0,2,3,8,9,12,13,15)$

P3. (10 points) Find the POS equivalent of the function shown below, simplify it using a K-map and implement the final expression using <u>only</u> NOR gates.
F(A, B, C, D) = Σm(0, 1, 4, 5, 10, 11, 14, 15)

P4. (15 points) Find the minimum SOP for the following functions F together with the don't-care conditions d.

(a) F(A,B,C) =Σm(3,5,6) + d(0,7)
(b) F(W,X,Y,Z) =Σm(0,2,4,5,8,14,15) +d(7,10,13)
(c) F(A,B,C,D) =Σm(4,6,7,8,12,15) +d(2,3,5,10,11,14)

P5. (10 points) Given the following logic functions:

F(A,B,C,D) = Sm(2, 3, 8, 9, 14, 15)
G(A,B,C,D) = Sm(0, 1, 5, 8, 9, 14, 15)

Design a minimum two-level OR-AND logic circuit to realize both logic functions.
(a minimum solution has eight gates).

P6. (10 points) Find the minimum-cost circuit consisting only of two-input NAND gates for the function f(x1, x2, x3, x4) = Σ m(0, 1, 2, 3, 4, 6, 8, 9, 12). Assume that the input variables are available in both uncomplemented and complemented forms. How many NAND gates did you use?

P7. (10 points) Find the minimum-cost circuit consisting only of two-input NOR gates for the function f(x1, x2, x3, x4) = Σ m(6, 7, 8, 10, 12, 14, 15). Assume that the input variables are available in both uncomplemented and complemented forms. How many NOR gates did you use?

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P8. (15 points) Consider the circuit in the figure below, which implements two functions f and g.

(a) (5 points) What is the cost of this circuit? You can assume that the input variables are available in both uncomplemented and complemented form.

(b) (10 points) Redesign the circuit to implements the same functions, but now try to minimize the cost as much as possible. What is the cost of your circuit?