

**University of California at Berkeley**  
**College of Engineering**  
**Department of Electrical Engineering and Computer Science**

EECS 150  
Spring 2007

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**Problem Set #1: Combinational Logic forms**  
**Assigned 16 January 2007, Due 26 January at 2 PM**

1. Use Boolean algebra to simplify into two-level sum of products form the following Boolean expressions. Show your intermediate steps of applying Boolean algebra axioms and theorems!
  - a.  $F(A,B,C) = A' B' C' + A B C' + A B' C'$
  - b.  $F(A, B, C, D) = A' B' C' D' + A' B' C' D + A' B' C D + A' B C D + A B' C' D' + A B' C' D + A B C' D + A B C D$
2. Given the following minimized two-level sum of products expressions, describe the functions in “little m” notation:
  - a.  $F(A,B,C) = A' B' + A B$
  - b.  $F(A,B,C,D) = C + A B + A' B C$
3. Given the following minimized two-level product of sums expressions, describe the functions in “big M” notation:
  - a.  $F(A, B, C) = (A' + C) (B + C')$
  - b.  $F(A, B, C, D) = (A' + B') (A' + C') (B + D')$
4. Use K-maps to simplify the following logical expressions into minimized two-level forms. Show how you have used K-maps to obtain your answers!
  - a.  $F(A, B, C) = A C + A B C' + A B' C' + A' B' C'$  (answer in sum of products form)
  - b.  $F(A, B, C) = \Pi M(2, 4, 6)$  (answer in product of sums form)
  - c.  $F(A, B, C, D) = \Sigma m(0, 4, 5, 8, 11, 12, 13)$  (answer in sum of products form)
  - d.  $F(A, B, C, D) = (A + C + D') (A + B + D) (A' + C + D') (B' + C + D')$  (answer in product of sums form)
5. Given that the Boolean function  $F(A, B, C) = A C' + A' B$ , answer the following questions. Show the intermediate work to arrive at the answer!
  - a. What is the corresponding expression in minimized product of sums form?
  - b. What is the corresponding expression for the complement of F in minimized sum of products form?
  - c. What is the corresponding expression for the complement of F in minimized product of sums form?

6.  $F(A,B,C,D) = B(C' + D')$  in minimized product of sums form. Answer the following questions, showing your intermediate steps:
- Show a K-map for F.
  - What is F in Big M notation?
  - What is F in Little M notation?
  - What is F in minimized two-level sum of products form?
  - Apply DeMorgan's Law to derive the complement of F, starting with the original product of sums expression.
  - Apply DeMorgan's Law to derive the complement of F given your answer to part d.
  - Using the K-map you filled in for part a, show how to derive the minimized complement of F in product of sums form. Is your answer the same as in part f? If not, why not?
  - Using the K-map you filled in for part a, show how to derive the minimized complement of F in sum of products form. Is your answer the same as in part e? If not, why not?