

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

EECS 150  
Fall 2005

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**Problem Set #1: Combinational Logic forms**  
**Assigned 31 August 2005, Due 9 September 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.  $F(A,B,C,D) = B' + B D + A B C$
3. Given the following minimized two-level product of sums expressions, describe the functions in “big M” notation:
  - a.  $F(A, B, C) = (A' + C) (A + C')$
  - b.  $F(A, B, C, D) = (A' + D') (A' + C') (C' + D')$
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.  $F(A, B, C) = \Pi M(3, 6, 7)$  (answer in product of sums form)
  - c.  $F(A, B, C, D) = \Sigma m(1, 2, 3, 6, 9, 10, 14)$  (answer in sum of products form)
  - d.  $F(A, B, C, D) = (A + C + D) (A' + C + D) (B' + C + D') (B' + C' + D')$  (answer in product of sums form)
5. Given that the Boolean function  $F(A, B, C) = B C' + A B$ , 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:

- a. Show a K-map for F.
- b. What is F in Big M notation?
- c. What is F in Little M notation?
- d. What is F in minimized two-level sum of products form?
- e. Apply DeMorgan's Law to derive the complement of F, starting with the original product of sums expression.
- f. Apply DeMorgan's Law to derive the complement of F given your answer to part d.
- g. 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 e? If not, why not?
- h. 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 f? If not, why not?