

University of Illinois at Urbana-Champaign
Department of Electrical and Computer Engineering

ECE 362/CS 362/MATH 391 : LOGIC DESIGN

Spring 2002

Problem Set 2

Canonical Forms, Karnaugh Maps, Prime Implicants, Minimal Sum of Products

Issued: Thursday, January 24th. **Due:** Beginning of lecture on Thursday, January 31st.

Reading from McCluskey: Chapter 6, Sections 6.1–6.4 (also review pages 50–51 for the Reed-Muller canonical form).

Problem 2.1

Problem 6.2 from McCluskey (functions f_1 , f_2 , f_3 only).

Problem 2.2

Consider the majority function $f(x_1, x_2, x_3)$ which evaluates to 1 if and only if the majority of its inputs are equal to 1. Give the following different forms for this function.

- (a) Canonical sum (i.e., sum of fundamental products).
- (b) Canonical product (i.e., product of fundamental sums).
- (c) Reed-Muller canonical form.
- (d) Complete sum (i.e., sum of all prime implicants).
- (e) A minimal sum of products form.

Problem 2.3

Consider the 2-bit comparison function $f(x_1, x_2, x_3, x_4)$ which evaluates to 1 if and only if the 2-bit integer x_1x_2 is less than or equal to the 2-bit x_3x_4 (x_1 and x_3 are the most significant bits). Answer the following questions.

- (a) Write down the Reed-Muller canonical form.
- (b) Draw a Karnaugh map for this function.
- (c) Write down the complete sum expression for this function.
- (d) List all essential prime implicants.
- (e) Write a minimal sum of products form.

Problem 2.4

Problem 6.3 from McCluskey.

Problem 2.5

Problem 6.4 from McCluskey.