

Name _____

CSE140 Midterm 1, Tuesday October 28, 2014

Please read the following instructions carefully: If you are unclear about any of the questions on the exam, make the most plausible assumption to answer the question. Instructors and proctors will not answer questions on the exam material. Please write your name on the top of each page. Write the names of the students to your left and right in the space provided.

Name of student to your left: _____

Name of student to your right: _____

	Total Points	Points Awarded
Problem 1	10	
Problem 2	10	
Problem 3	15	
Problem 4	15	
Problem 5	25	
Problem 6	25	
Total	100	

All the Best!

1 True or False

Circle your choice of true or false. Use one sentence to explain your choice.

1. The variables of a Boolean expression have to be binary (0 or 1). **(2pt)**
True False
2. DeMorgan's theorem can be proven with the laws of Boolean algebra. **(2pt)**
True False
3. The theorem of Shannon's expansion is valid for Boolean algebra. **(2pt)**
True False
4. In a K-map, each variable always separates the whole map into two subspaces of the same size. **(2pt)**
True False
5. For a K-map of n variables, each cell has at most $n - 1$ neighbors. **(2pt)**
True False

2 Problem Formulation and Canonical Expression

A 2-bit adder inputs two binary numbers (a_1, a_0) , (b_1, b_0) , and a carry-in bit c_{in} , and outputs the sum (s_1, s_0) and a carry-out bit c_{out} .

1 Write the truth table of the outputs c_{out}, s_1, s_0 (5pts).

2 Describe function c_{out} in the canonical sum-of-products (minterms) format (5pts).

3 Consensus Theorem

Prove the following using Boolean algebra (15pts).

$$abc + c'd + abd = abc + c'd.$$

4 Shannon's Expansion

Prove the equality of the following switching functions using Shannon's expansion (15pts).

$$(a+b+c)(c'+d)(a+b+d+e) = (a+b+c)(c'+d).$$

5 Karnaugh Map: Sum of Products Expressions

Use Karnaugh map to simplify function

$$f(a,b,c,d) = \sum m(0,2,5,10,12) + \sum d(1,3,4,8,14).$$

List all possible minimal sum of products expressions. Show the Boolean expressions. No need for the logic diagram (25pts).

6 Karnaugh Map: Product of Sums Expressions

Use Karnaugh map to simplify function

$$f(a,b,c,d) = \sum m(6,7,9,11,13,15) + \sum d(1,3,4,8,14).$$

List all possible minimal product of sums expressions. Show the Boolean expressions. No need for the logic diagram (25pts).