

Name _____

CSE140 Midterm 1, Tuesday May 2, 2017

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	24	
Problem 2	16	
Problem 3	20	
Problem 4	20	
Problem 5	20	
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 duality of Boolean algebra only applies to the statement that can be proven by the laws/theorems of Boolean algebra. **(4pts)**

True False

2. For an OR gate, a "0" at input dominates the output (blocks the message of other inputs). **(4pts)**

True False

3. Shannon's expansion can be proven by the laws and theorems of Boolean algebra. **(4pts)**

True False

4. {NAND} is a universal set of gates. **(4pts)**

True False

5. $\{f(a,b,c) = a'b' + b'c' + a'c'\}$ is a universal set of gates. **(4pts)**

True False

6. Let $f(a,b,c)$ be a majority voting machine, i.e. f is true when more than half of the input bits are 1, then $\{f(a,b,c)\}$ is a universal set of gates. **(4pts)**

True False

2 Consensus Theorem

Prove the following equation using **Boolean algebra** (using the laws and theorems of Boolean algebra but not the techniques of switching function system). Write down explicitly the laws used in the derivation(16pts).

1. $abd + cd'e + abce = abd + cd'e.$

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

3 Karnaugh Map: Sum of Products Expressions

Use Karnaugh map to simplify function

$$f(a, b, c, d) = \sum m(0, 2, 3, 5, 8, 11, 13) + \sum d(4, 7, 9, 10, 15).$$

List all possible minimal sum of products expressions. Write the switching function. No need for the logic diagram (20pts).

4 Karnaugh Map: Product of Sums Expressions

Use Karnaugh map to simplify function

$$f(a, b, c) = \sum m(0, 3, 7) + \sum d(5).$$

List all possible minimal product of sums expressions. Write the switching function. No need for the logic diagram (20pts).

5 Other Types of Gates

Consider the function $f(x,y)$ where $\oplus$ is an Exclusive OR operator:

$$f(x,y) = (x + y) \oplus (x' + y') \oplus xy \oplus x'y' \oplus (x + y').$$

Simplify the function into a minimal sum of products expression using switching function techniques e.g. Shannon's expansion. Show your derivation (20pts). (10 points).