

Name _____

Name of student to your left _____

Name of student to your right _____

CSE140 Midterm 1, Section A, Tuesday April 24, 2018

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.

	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. For Boolean algebra, given an equation $a + b = a$, we can deduce that $b = 0$. **(4pts)**

True False

Explanation:

2. In Boolean algebra, given the theorem that $a + 1 = 1$, we can derive from duality that $a' \cdot 0 = 0$ but not $a \cdot 0 = 0$. **(4pts)**

True False

Explanation:

3. For a four input switching function, i.e. $f(a, b, c, d)$ and its corresponding K-map, the number of essential prime implicants may not be larger than 8. **(4pts)**

True False

Explanation:

4. Shannon's expansion has $f(x, y, z) = (x' + f(0, y, z)) \cdot (x + f(1, y, z))$. **(4pts)**

True False

Explanation:

5. {AND, OR} is a universal set of gates. **(4pts)**

True False

Explanation:

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

True False

Explanation:

2 Consensus Theorem Application

2.1 List all consensuses between the pair(s) of product terms in the following sum of products expressions.(8pts)

1. $a'b' + a'c + bc$: Consensus(es) _____.

2. $ab'cd + abde' + a'c'e$: Consensus(es) _____.

3. $abcd + a'd + efg$: Consensus(es) _____.

4. $ab'cd + a'de + bde'$: Consensus(es) _____.

2.2 List all consensuses of the pair(s) of sum terms in the following product of sums expressions.(8pts)

1. $(a' + b')(a' + c')(b + c')$: Consensus(es) _____.

2. $(a + b' + c')(a + c + e)(a' + c + d)$: Consensus(es) _____.

3. $(a + b' + c + d)(a + c + d + e)(a' + c + d)$: Consensus(es) _____.

4. $(a + b + c)(a + d')(a + b' + e)(a' + c + d)$: Consensus(es) _____.

3 Karnaugh Map: Sum of Products Expressions

Use Karnaugh map to simplify function

$$f(a, b, c, d) = \sum m(0, 1, 3, 5, 7, 8, 12, 14, 15) + \sum d(6, 10, 11).$$

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

$$f(a, b, c) = \sum m(0, 2, 5) + \sum d(3, 6).$$

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 and the priority of the operators is AND (first), Exclusive OR and OR (last):

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

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