



## Ve270 Introduction to Logic Design

### Homework 2

**Assigned: May 21, 2020**

**Due: May 28, 2020, 2:00pm.**

**A pop quiz will be given on the due date.**

1. Prove DeMorgan's Law. (5 points)

2. Problem 2.28. (5 points)

2.28 Use algebraic manipulation to convert the following equation to sum-of-products form:  $F = a'b(c + d') + a(b' + c) + a(b + d)c$

3. Problem 2.30. (5 points)

2.30 Use DeMorgan's Law to find the inverse of the following equation:  $F = ac' + abd' + acd$ . Reduce to sum-of-products form.

4. Problem 2.37 (5 points)

2.37 Convert the function  $F$  shown in the truth table in Table 2.9 to an equation. Don't minimize the equation.

Table 2.9

a	b	c	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

5. Problem 2.38 (5 points)

2.38 Use algebraic manipulation to minimize the equation obtained in Exercise 2.37

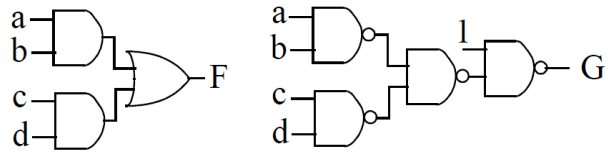
6. Problem 2.48 (c) (5 points)

2.48 Convert the following Boolean equations to canonical sum-of-minterms form:

c.  $F(a,b,c) = abc + ab + a + b + c$

7. Problem 2.52 (10 points)

2.52 Determine whether the two circuits in Figure 2.81 are equivalent circuits using: (a) algebraic manipulation, and (b) truth tables.



8. Problem 2.54 (10 points)

2.54 A museum has three rooms, each with a motion sensor ( $m_0$ ,  $m_1$ , and  $m_2$ ) that outputs 1 when motion is detected. At night, the only person in the museum is one security guard who walks from room to room. Create a circuit that sounds an alarm (by setting an output A to 1) if motion is ever detected in more than one room at a time (i.e., in two or three rooms), meaning there must be one or more intruders in the museum. Start with a truth table.

9. Problem 6.3. (10 points)

6.3) Perform two-level logic size optimization for  $F(a,b,c) = ab'c + abc + a'bc + abc'$  using (a) algebraic methods, (b) a K-map. Express the answers in sum-of-products form.

10. Problem 6.6, using both algebraic methods and K-map. (10 points)

6.6) Perform two-level logic size optimization  $F(a, b, c, d) = ab + a'b'd'$

11. Problem 6.8. (10 points)

6.8) Perform two-level logic size optimization for  $F(a, b, c, d) = a'bc'd + ab'cd'$ , assuming that a and b can never both be 1 at the same time, and that c and d can never both be 1 at the same time (i.e., there are don't cares).

12. Problem 6.10 (a) (10 points) (b) is not needed!

6.10) For the function  $F(a, b, c) = a'c + ac + a'b$ , determine all prime implicants and all essential prime implicants: (a) using a K-map, (b) using the tabular method.

13. Problem 6.14 (10 points)



6.14) Using algebraic methods, reduce the number of gate inputs for the following equation by creating a multilevel circuit:  $F(a, b, c, d, e, f, g) = abcde + abcd'e'fg + abcd'e'f'g'$ . Assume only AND, OR, and NOT gates will be used. Draw the circuit for the original equation and for the multilevel circuit, and clearly list the delay and number of gate inputs for each circuit.