Digital engineering 2nd report

*** 제출: 4월 23일 중간고사 시험장에 지참 후 제출**

*** 디지털 공학 과제 주의사항**

1. 과제는 반드시 **자필**로 작성하셔야 합니다.
2. **문제 풀이 과정**이 다 들어가 있어야 하며, 답에는 반드시 **밑줄이나 박스** 등의 답을 알아볼 수 있는 표기 바랍니다.
3. **A4용지**에 반드시 **학번 이름**을 포함하여 제출바랍니다.
4. 문제는 **7판 원서** 기준으로 출제되었습니다.
5. 스테이플러는 종이 **왼쪽 상단**에 찍어주시기 바랍니다.
6. 문제의 순서가 명확하도록 **페이지 번호** 표기바랍니다.

3.10

3.10 (a) Reduce to a minimum sum of products (three terms):
$(X + W)(Y \oplus Z) + XW'$

(b) Reduce to a minimum sum of products (four terms):
$(A \oplus BC) + BD + ACD$

(c) Reduce to a minimum product of sums (three terms):
$(A' + C' + D')(A' + B + C')(A + B + D)(A + C + D)$

3.15

3.15 Multiply out to obtain a sum of products:

(a) $(K' + M' + N)(K' + M)(L + M' + N')(K' + L + M)(M + N)$ (three terms)
(b) $(K' + L' + M')(K + M + N')(K + L)(K' + N)(K' + M + N)$
(c) $(K' + L' + M)(K + N')(K' + L + N')(K + L)(K + M + N')$
(d) $(K + L + M)(K' + L' + N')(K' + L' + M')(K + L + N)$
(e) $(K + L + M)(K + M + N)(K' + L' + M')(K' + M' + N')$

3.31

3.31 Prove algebraically:

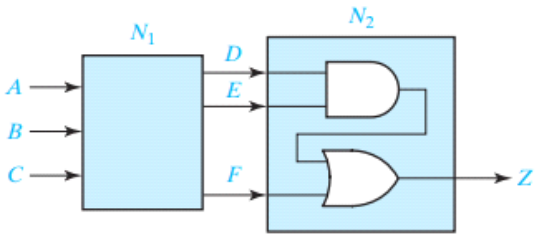
(a) $(X' + Y')(X \equiv Z) + (X + Y)(X \oplus Z) = (X \oplus Y) + Z'$
(b) $(W' + X + Y')(W + X' + Y)(W + Y' + Z) = X'Y' + WX + XYZ + W'YZ$
(c) $ABC + A'C'D' + A'BD' + ACD = (A' + C)(A + D')(B + C' + D)$

3.34

3.34 Simplify the following expression to a sum of two terms and then factor the result to obtain a product of sums: $abd'f' + b'cegh' + abd'f + acd'e + b'ce$

4.5

4.5 A combinational circuit is divided into two subcircuits N_1 and N_2 as shown. The truth table for N_1 is given. Assume that the input combinations $ABC = 110$ and $ABC = 010$ never occur. Change as many of the values of D, E, and F to don't-cares as you can without changing the value of the output Z.



A	B	C	D	E	F
0	0	0	1	1	0
0	0	1	0	0	1
0	1	0	0	1	1
0	1	1	1	1	1
1	0	0	1	0	0
1	0	1	1	0	1
1	1	0	0	1	0
1	1	1	0	0	0

4.10

4.10 Work Problem 4.9 using:
$F(a, b, c, d) = (a + b + d)(a' + c)(a' + b' + c')(a + b + c' + d')$

4.14

4.14 Design a combinational logic circuit which has one output Z and a 4-bit input $ABCD$ representing a binary number. Z should be 1 iff the input is at least 5, but is no greater than 11. Use one OR gate (three inputs) and three AND gates (with no more than three inputs each).

4.44

4.44 Show that a full subtractor can be implemented using two 2-input exclusive OR gates, one inverter, and three 2-input NOR gates. (*Hint:* Write the borrow out equation in product-of-sums form.)

5.6

5.6 Find the minimum sum-of-products expression for each function. Underline the essential prime implicants in your answer and tell which minterm makes each one essential.

(a) $f(a, b, c, d) = \Sigma\, m(0, 1, 3, 5, 6, 7, 11, 12, 14)$
(b) $f(a, b, c, d) = \Pi\, M(1, 9, 11, 12, 14)$
(c) $f(a, b, c, d) = \Pi\, M(5, 7, 13, 14, 15) \cdot \Pi\, D(1, 2, 3, 9)$

5.25

5.25 Work Problem 5.24 for the following:

(a) $f(a, b, c, d) = \Sigma\, m(1, 3, 4, 5, 7, 9, 13, 15)$
(b) $f(a, b, c, d) = \Pi\, M(0, 3, 5, 8, 11)$
(c) $f(a, b, c, d) = \Sigma\, m(0, 2, 6, 9, 13, 14) + \Sigma\, d(3, 8, 10)$
(d) $f(a, b, c, d) = \Pi\, M(0, 2, 6, 7, 9, 12, 13) \cdot \Pi\, D(1, 3, 5)$

7.6

7.6 Realize $Z = ABC + AD + C'D'$ using only two-input NAND gates. Use as few gates as possible.

7.14

7.14 Using AND and OR gates, find a minimum circuit to realize

$$f(a, b, c, d) = M_0\, M_1\, M_3\, M_{13}\, M_{14}\, M_{15}$$

(a) using two-level logic
(b) using three-level logic (12 gate inputs minimum)