Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

EENG115/INFE115 Introduction to Logic Design
EENG211/INFE211 - Digital Logic Design I

Fall 2009-10

Instructors:
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Midterm EXAMINATION
Nov 24, 2009

Duration : 90 minutes
Number of Problems: 10

Good Luck

ST. NUMBER	
ST. NAME AND SURNAME	SOLUTIONS
ST. GROUP NO	

Problem	Score	Points
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		

1. Convert the following binary numbers to decimal:
   a. 110110100 (**? pts**.)=256+128+32+16+4= 436
   b. 10101101 (**? pts**.)= 128+32+8+4+1=173

2. Convert the following decimal numbers to the bases indicated.
   a. 175 to binary =10101111 (? **pts**.)
   b. 175 to octal $=257_8$ (**? pts**.)
   c. 175 to hexadecimal = AF_{16} (**? pts**.)

3. Perform the following addition by using signed-2's complement of the decimal numbers.
   a. (-48)+(-25) (**? pts**.)
   b. (-72) - (-27) (**? pts**.)

a. $48_{10}=00110000_2$ -48=11010000
   $25_{10}=00011001_2$ -25=11100111

-48	11010000
+(-25)	11100111
	110110111
-73	

$72_{10}=01001000$ -72=10111000

$27_{10}=00011011$ -72+27= 1 0 1 1 1 0 0 0
0 0 0 1 1 0 1 1
1 1 0 1 0 0 1 1

4. Simplify the following expressions using Boolean algebra.
   a. AB + A(CD + CD') (**? pts**.)
   b. (BC' + A'D) (AB' + CD') (**? pts**.)

a. AB + A(C(D+D'))=AB + AC = A(B+C)

b. 0

5. Given the Boolean expression F = x'y + xyz':
   a. Derive an algebraic expression for the complement F'. (**? pts**.)
   b. Show that F·F' = 0. (**? pts**.)
   c. Show that F+F' = 1. (**? pts**.)

F'=(x+y')(x'+y'+z)

F.F'=(x'y + xyz') (x+y')(x'+y'+z)= (x'y + xyz')(xy'+xz+x'y'+y'+y'z)=0

F= x'y + xyz'+ xy'+xz+x'y'+y'+y'z

F=x'(y+y')+y'(1+x+z)+x(yz'+z)

=x'+y'+x(y+z)=x'+y'+xy+xz=(x'+x)(x'+y)+y'+xz=1+x'+xz=1

6. Simplify the following Boolean function, using 3-variable Karnaugh map:
   F (x,y,z) = ∑ (0,2,6,7) (**? pts**.)

x\yz	00	01	11	10
0	1			1
1			1	1

F=x'z'+xy

7. Simplify the following Boolean function, using 4-variable Karnaugh map:
   F (x,y,z,w) = w'z + xz + x'y + wx'z (**? pts**.)

xy\zw	00	01	11	10
00			1	1
01	1	1	1	1
11			1	1
10			1	1

F=z+x'y

8. Simplify the following Boolean function F, together with the don't-care onditions *d,* and then express the simplified function in
   a. sum of products and (**? pts**.)
   b. product of sums. (**? pts**.)

$$F(A,B,C,D) = \sum(1,3,5,7,9,15),\ d(A,B,C,D) = \sum(4,6,12,13)$$

AB\CD	00	01	11	10
00		1	1	
01	x	x	1	x
11	x	x	1	
10		1		

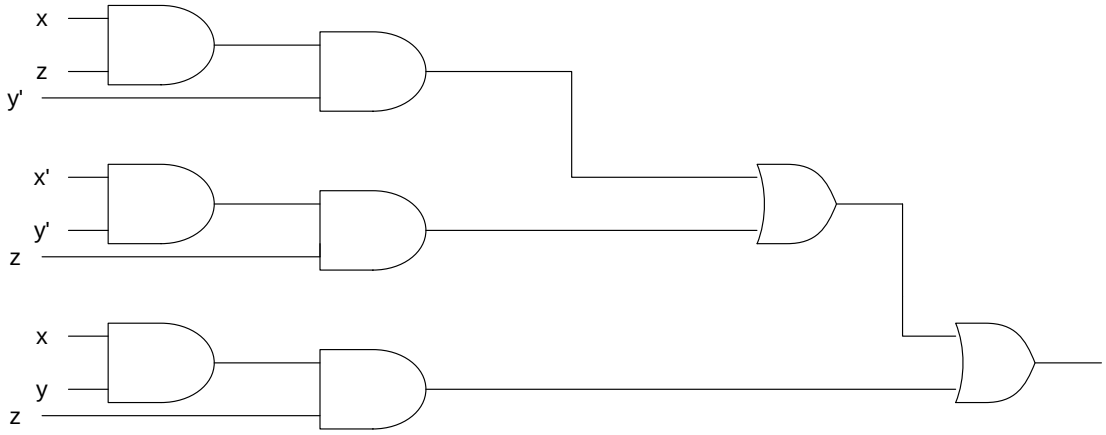
F=A'D+BD+C'D

F'=D'+AB'C

F=D(A'+B+C')

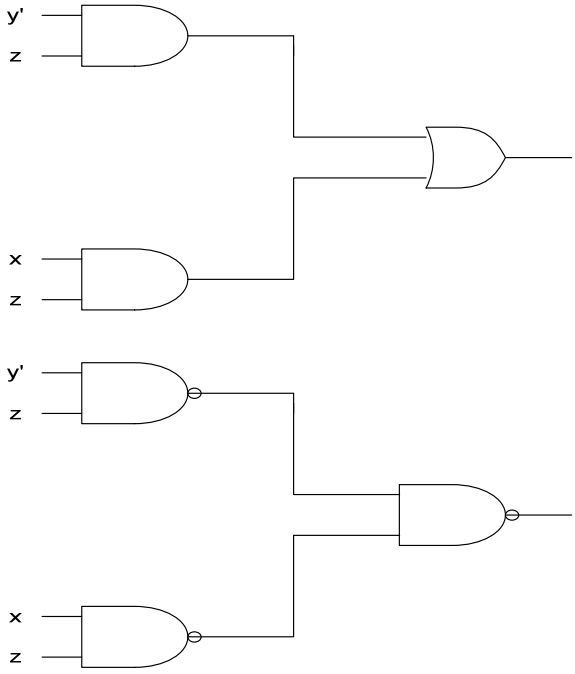
9. Given the Boolean function F = xy'z + x'y'z + xyz
   a. List the truth table (**? pts**.)
   b. Draw the logic diagram of the original function using 2-input gates (**? pts**.)
   c. Simplify the function
   d. Draw the logic diagram of the simplified function (using 2-input gates) (**? pts**.)
   e. Draw the logic diagram of the simplified function using only 2-input NAND gates. (**? pts**.)

x	y	z	xy'z+x'y'z+xyz
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



x\yz	00	01	11	10
0	0	1	0	0
1	0	1	1	0

F=y'z+xz



10. Implement the following Boolean function together with the don't-care conditions *d*, using no more than three NOR gates:
    a. $F(A,B,C,D) = \sum(0,1,9,11)$
    b. $d(A,B,C,D) = \sum(2,8,10,14,15)$

AB\CD	00	01	11	10
00	1	1	0	x
01	0	0	0	0
11	0	0	x	x
10	x	1	1	x

F'=BC'+A'C

F=(B'+C)(A+C')