Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

EENG115/INFE115 Introduction to Logic Design

EENG211/INFE211 Digital Logic Design I

Fall 2011-12

Instructors:

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Midterm EXAMINATION

Nov.22, 2011

Duration:100 minutes

Number of Problems: 6

Good Luck

STUDENT'S	
NUMBER	
NAME	
SURNAME	
GROUP NO	

Problem	Achieved	Maximum
1		10
2		10
3		20
4		20
5		20
6		20
TOTAL		100

Question 1 (10 points)

a. Convert the following binary numbers to the indicated bases.(6 pts.)

i. 10111011 to octal

$010\ 111\ 011 = (273)_8$

2 7 3

ii. 1011011101 to hexadecimal

$0010\ 1101\ 1101 = (2DD)_{16}$

2 D D

iii. 11000101.101 to decimal

$1*2^7 + 1*2^6 + 0*2^5 + 0 * 2^4 + 0*2^3 + 1*2^2 + 0*2 + 1 + 1*2^{-1} + 0*2^{-2} + 1*2^{-3} =$
$128+64+4+1+0.5+0.125=197.625$

b. Convert the octal number $(36.065)_8$ to binary and hexadecimal.(4 pts.)

3	6	.	0	6	5
00011	110	.	000	110	101000

Binary Equivalent

1 E . 1 A 8

$(36.065)_8 = (11110.000110101)_2 = (1E.1A8)_{16}$

Question 2 (10 points):

a) Find the (r-1)'s and r's complements of the following numbers in the indicated bases. (4 pts.)

i. $(8649)_{10}$

9's complement: 1350
10's complement: 1351

ii. $(10111011)_2$

1's complement: 01000100
2's complement: 01000101

b) Perform the following operations by using signed 2's complement of decimal numbers (6 pts.)

i.) (-29) + (-43)

```
29 = 00011101  -29 = 11100011   11100011
43 = 00101011  -43 = 11010101   11010101
                                --------
                               ±10111000
```

The result is –(01001000) = -72

ii) (-66) - (-75) =-66+75

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66 = 01000010   -66 = 10111110
75 = 01001011

 10111110
 01001011
---------
±00001001
```

The result is 1001 = 9

Question 3 (20 points):

a) Construct truth table for the following function (5 pts.)

$$F(A,B,C)=AC' +ABC +A'C'$$

A	B	C	A'	C'	AC'	ABC	A'C'	AC'+ABC+A'C'
0	0	0	1	1	0	0	1	1
0	0	1	1	0	0	0	0	0
0	1	0	1	1	0	0	1	1
0	1	1	1	0	0	0	0	0
1	0	0	0	1	1	0	0	1
1	0	1	0	0	0	0	0	0
1	1	0	0	1	1	0	0	1
1	1	1	0	0	0	1	0	1

b) Use the truth table of (a) to write the function F in

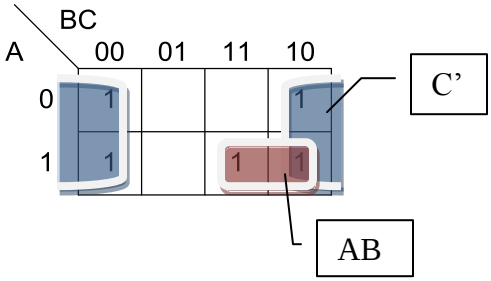
i. sum of minterms form, (2.5 pts.)

$$F(A,B,C) = \sum (0,2,4,6,7)$$

ii. product of Maxterms form. (2.5 pts.)

$$F(A,B,C) = \prod (1,3,5)$$

c) Simplify the following function F in (a) using Karnaugh map. (5 pts.)



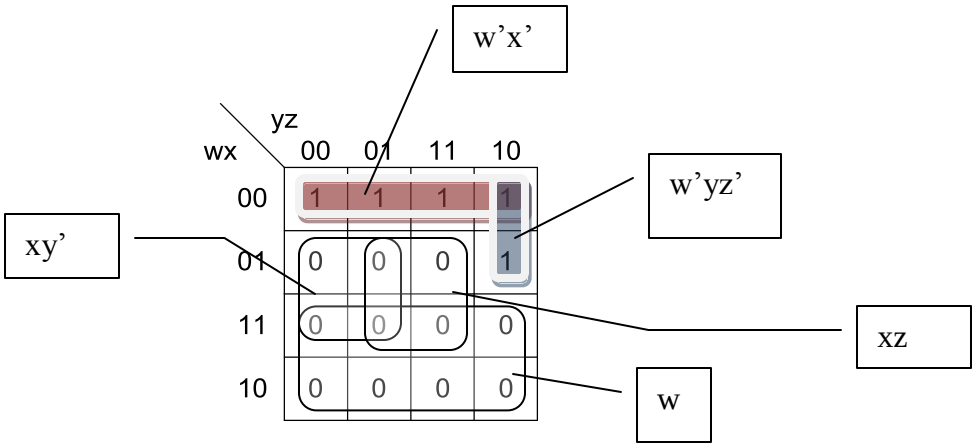
F(A,B,C)=AB+C'

Question 4 (20 points):

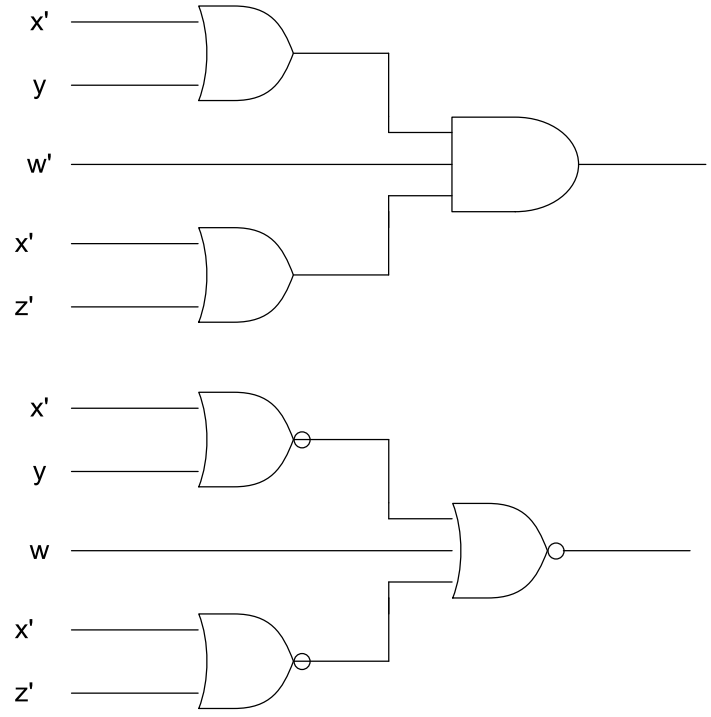
Implement the following Boolean function *F* using two-level forms of logic by using

(a) NOR gates only,
(b) NAND gates only,
(c) OR-NAND,
(d) AND-NOR.

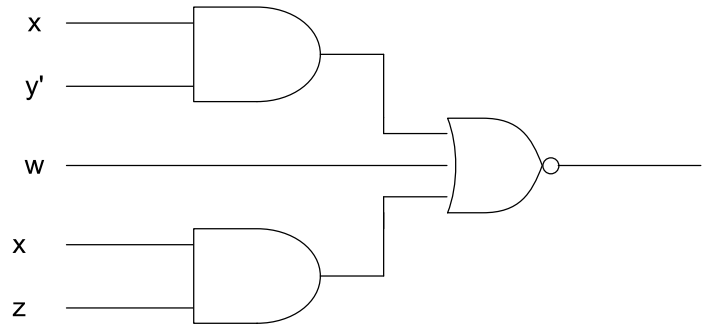
$$F(w,x,y,z) = w'x' + w'x'z + w'yz'$$



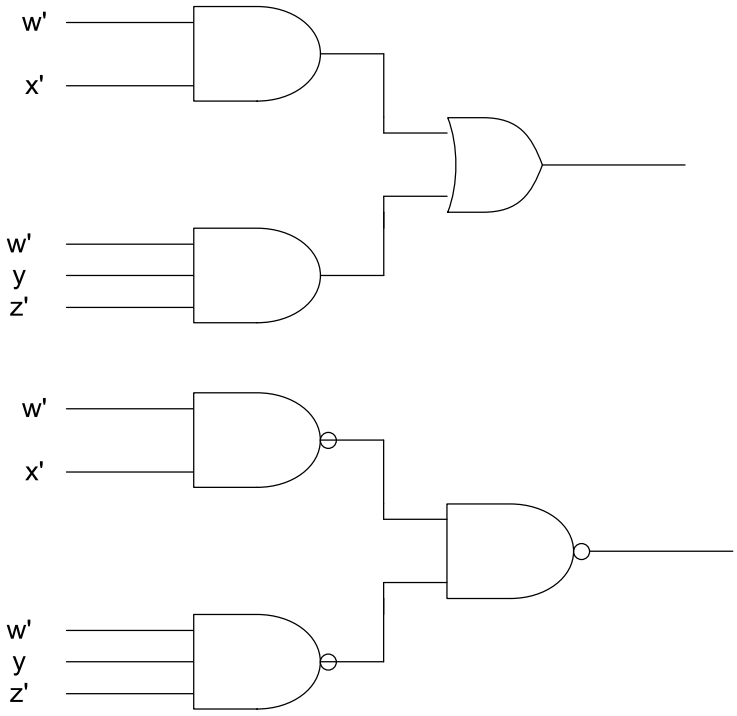
F'(w,x,y,z)= w +xy' +xz
F(w,x,y,z)= w'(x'+y)(x'+z') for NOR implementation



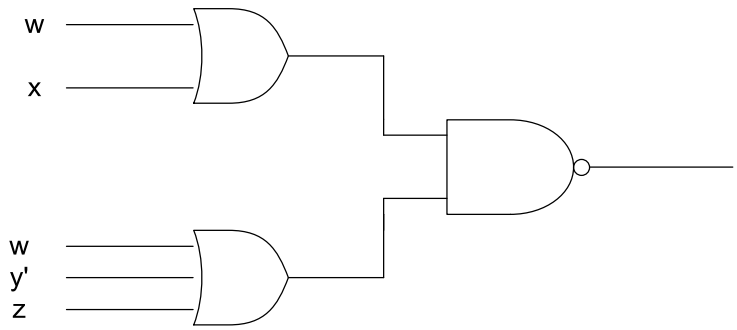
F(w,x,y,z)=(w +xy' +xz)' for AND-NOR implementation



F(w,x,y,z)=w'x'+w'yz'



F'(w,x,y,z)= (w+x)(w+y'+z)
F(w,x,y,z)=((w+x)(w+y'+z))' for OR-NAND implementation



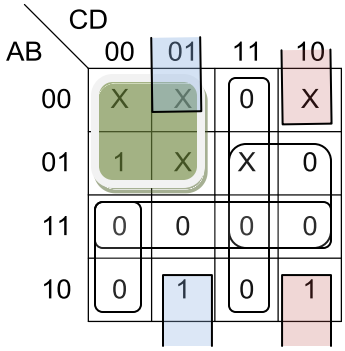
Question 5 (20 points):

Implement the following Boolean function *F*, together with the don't-care conditions *d*. Use minimum number of gates in your implementations. Generate two implementations one of which is using

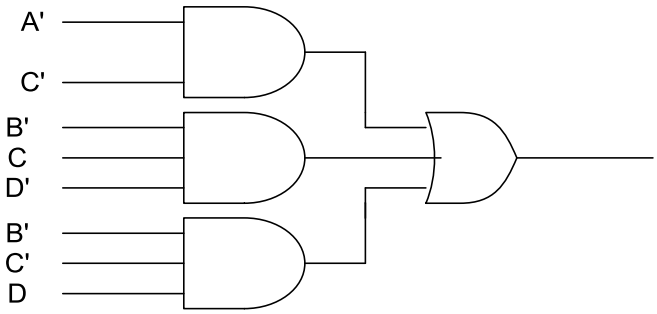
a.) two-levelNAND gates.

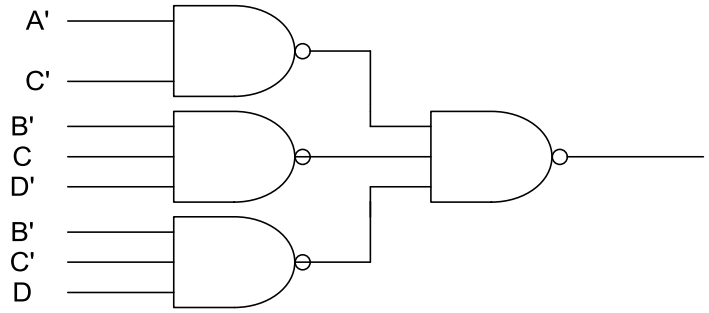
b.) two-level NOR gates.

$$F(A,B,C,D) = \sum (4,9,10)$$
$$d(A,B,C,D) = \sum (0,1,2,5,7)$$

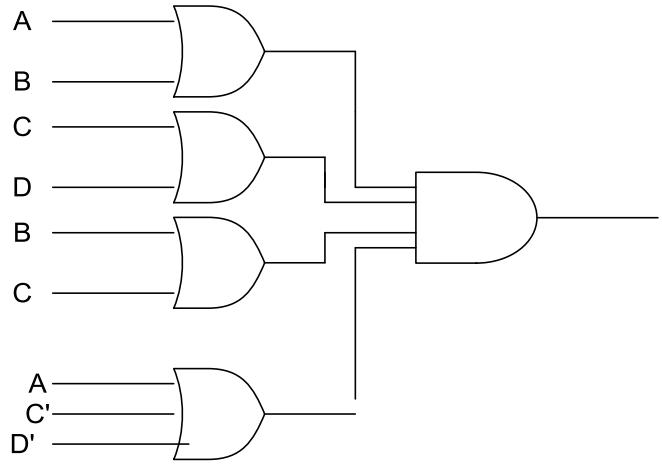


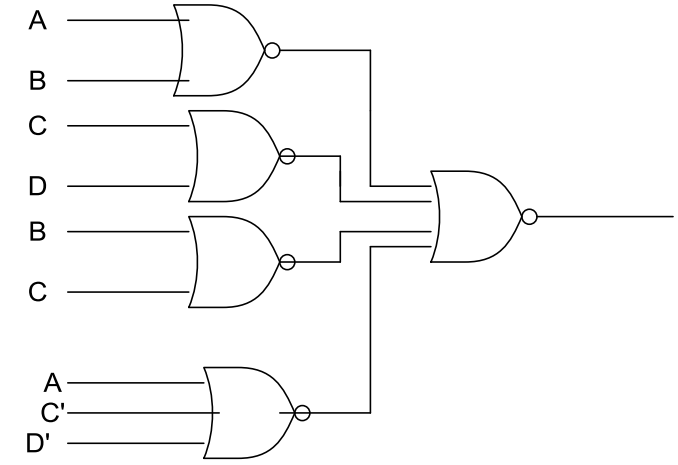
F(A,B,C,D)=A'C'+B'C'D +B'CD'





F'(A,B,C,D)=AB+CD+BC+AC'D'
F(A,B,C,D)=(A'+B')(C'+D')(B'+C')(A'+C+D)



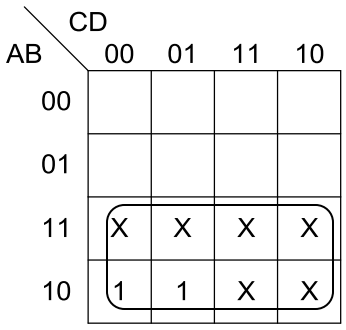


Question 6 (20 points):

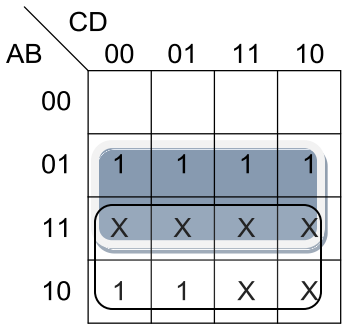
Design a digital converter circuit which converts BCD to Gray Code. Use don't care conditions indicated below.

BCD Code ABCD	Gray Code wxyz
0000	0000
0001	0001
0010	0011
0011	0010
0100	0110
0101	0111
0110	0101
0111	0100
1000	1100
1001	1101
1010	xxxx
1011	xxxx
1100	xxxx
1101	xxxx
1110	xxxx
1111	xxxx

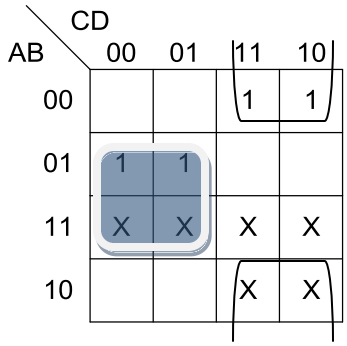
w=A



x = A + B

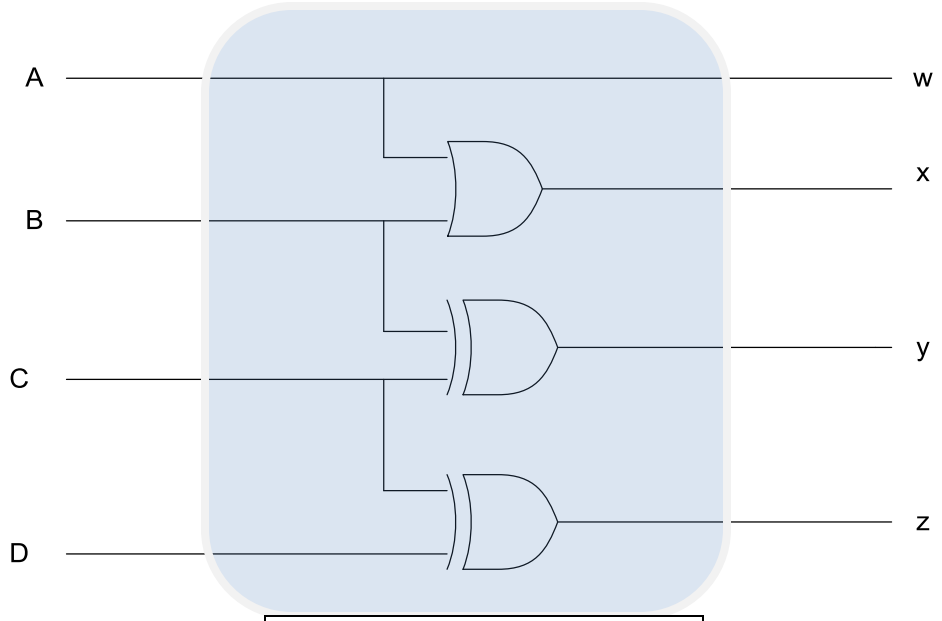


y=BC'+B'C



Z=C'D+CD'

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



BCD to Gray Code Converter