The University of Alabama in Huntsville
ECE Department
EE 202 – 01
Test 1 Solution
Spring 2017

In order to get full credit, you *must* show your work! You may use additional sheets of paper for your work, please put your name on each additional sheet. You *may* use a calculator.

x + 0 = x	x · 1 = x
x + x' = 1	x · x' = 0
x + x = x	x · x = x
x + 1 = 1	x · 0 = 0
(x')' = x	
x + y = y + x	xy = yx
x + (y + z) = (x + y) + z	x(yz) = (xy)z
x(y + z) = xy + xz	x + yz = (x + y)(x + z)
(x + y)' = x'y'	(xy)' = x' + y'
x + xy = x	x(x + y) = x

1. (1 point) The output of a two input AND gate is 1 if _**both**_ of the inputs are 1.
2. (1 point).Definitions of logical operations may be listed in a compact form called a _**K-map**_.
3. (1 point) A _**literal**_ is a single variable within a term, in complemented or uncomplemented form.
4. (1 point) A _**register**_ is a group of binary cells.
5. (1 point).For n bits, there are _**2^n**_ distinct combinations of 0s and 1s.
6. (10 points) Convert (20453_7) to decimal:

   $2 \times 7^4 + 0 \times 7^3 + 4 \times 7^2 + 5 \times 7^1 + 3 \times 7^0 = 2 \times 2401 + 0 \times 343 + 4 \times 49 + 5 \times 7 + 3 \times 1 = 4802 + 0 + 196 + 35 + 3 = 5036$

7. (15 points) Obtain the truth table of the following function and express it in sum-of-minterms and product-of-maxterms forms.

F = (w'+ x'z)(xyz + yz' + wx)

w	x	y	z	(w' + x'z)	xyz + yz' +wx)	F
0	0	0	0	**1**	**0**	**0**
0	0	0	1	**1**	**0**	**0**
0	0	1	0	**1**	**1**	**1**
0	0	1	1	**1**	**0**	**0**
0	1	0	0	**1**	**0**	**0**
0	1	0	1	**1**	**0**	**0**
0	1	1	0	**1**	**1**	**1**
0	1	1	1	**1**	**1**	**1**
1	0	0	0	**0**	**0**	**0**
1	0	0	1	**1**	**0**	**0**
1	0	1	0	**0**	**1**	**0**
1	0	1	1	**1**	**0**	**0**
1	1	0	0	**0**	**1**	**0**
1	1	0	1	**0**	**1**	**0**
1	1	1	0	**0**	**1**	**0**
1	1	1	1	**0**	**1**	**0**

F = $\sum$(2, 6, 7), F = (0, 1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14,15)

8. (15 points) Convert decimal +106 and +72 to binary, using the 8-bit signed-2's-complement representation. Then perform the binary equivalent of (-106) + (-72). Convert the answer back to decimal and verify that it is correct or explain why it is not.

+106 = 0 × -128 + 1 × 64 + 1 × 32 + 0 × 16 + 1 × 8 + 0 × 4 + 1 × 2 + 0 × 1 = `0110 1010`

+72 = 0 × -128 + 1 × 64 + 0 × 32 + 0 × 16 + 1 × 8 + 0 × 4 + 0 × 2 + 0 × 1 = `0100 1000`

-106 = 1 × -128 + 0 × 64 + 0 × 32 + 1 × 16 + 0 × 8 + 1 × 4 + 1 × 2 + 0 × 1= `1001 0110`

-72 = 1 × -128 + 0 × 64 + 1 × 32 + 1 × 16 + 1× 8 + 0 × 4 + 0 × 2 + 0 × 1 = `1011 1000`

```
-106  1001 0110
- 72  1011 1000
     ---------
     0100 1110
```

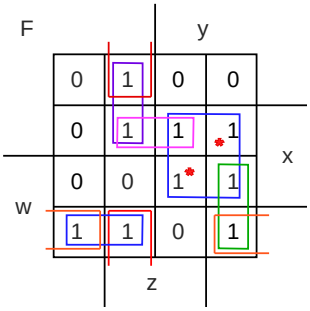
`0100 1110` = 0×-128 + 1×64 + 0×32 + 0×16 + 1×8 + 1×4 + 1×2+ 0×1 = 0 + 64 + 0 + 0 + 8 + 4 +2 = 78☒, It doesn't match because we have overflow, -128 is the most negative number and the result of -106 + -72 = -178

9. (5 points) Convert 01 1100 1110 0011 1100 0010 1010 1100 to hexadecimal

$1CE3C2AC_{16}$

10. (15 points) Find all the prime implicants for sum of products for the following Boolean function, ***and*** determine which are essential:

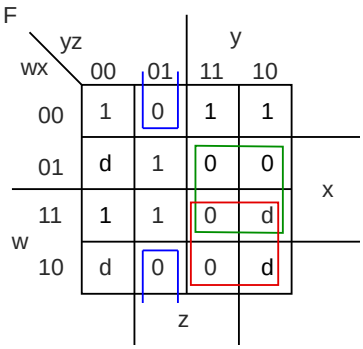
F (w, x, y, z) =Σ (1, 5, 6, 7, 8, 9, 10, 14, 15)



Implicants	Essential
xy	yes
w'y'z	no
w'xz	no
wyz'	no
wx'y'	no
x'y'z	no
wx'z'	no

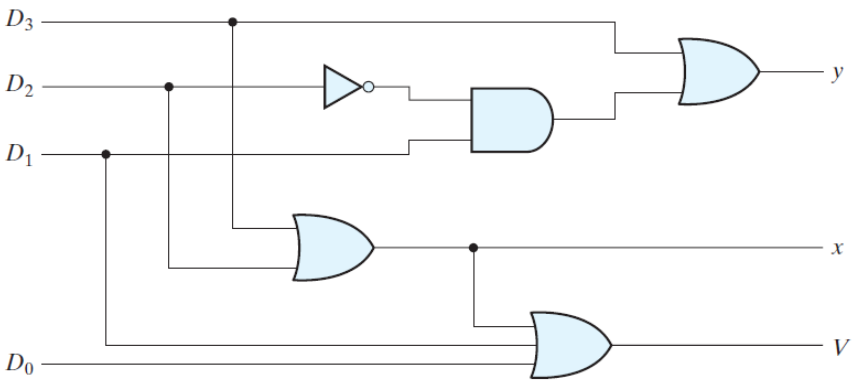
11. (15 points) Simplify the following Boolean function as a product of sums, using a four-variable map.

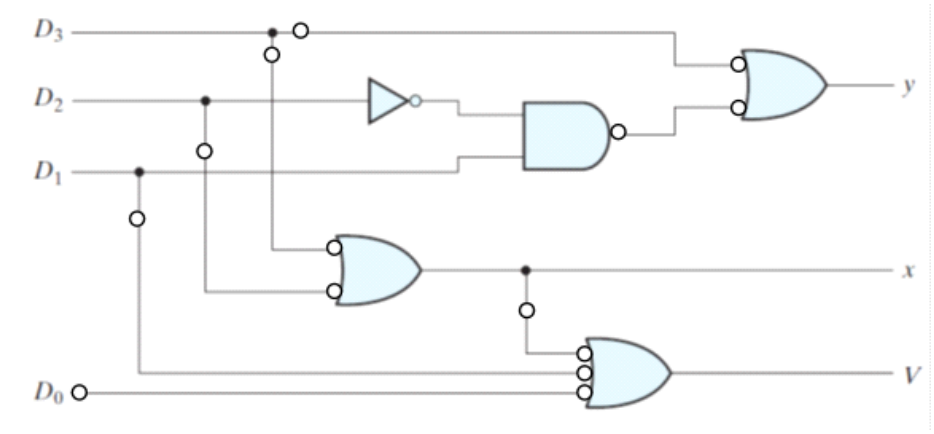
F (w, x, y, z) = Σ(0, 2, 3, 5, 12, 13))
d (w, x, y, z) = Σ(4, 8, 10, 14)

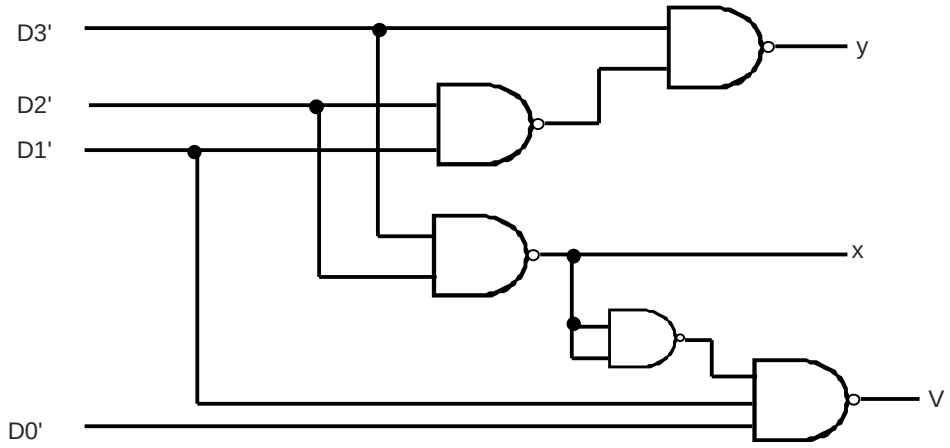


F' = xy + wy + x'y'z
F = (xy + wy + x'y'z)'
F = (xy)'(wy)'(x'y'z)'
F = (x' + y')(w' + y')(x + y + z')

12. (10 points) Convert the following circuit into a circuit that contains only NAND gates.







13. (10 points) Formulate a weighted binary code for the decimal digits, using weights 1325

Number	1	3	2	5
0	0	0	0	0
1	1	0	0	0
2	0	0	1	0
3	0	1	0	0
4	1	1	0	0
5	0	0	0	1
6	1	0	0	1
7	0	0	1	1
8	0	1	0	1
9	1	1	0	1