American University of Beirut
Department of Electrical and Computer Engineering

EECE 320 – Digital Systems Design
Assignment 2

16/10/2007

Suggested problems: Solve the drill problems 4.6-4.11of chapter 4.

Problem 1: Simplify the Boolean expressions to a minimum number of literals:

a) wxy' + wy'z'+wx'z'
b) ABC+A'B+ABC'
c) (BC'+A'D)(AB'+CD')
d) A'B(D'+C'D)+B(A+A'CD) (reduce to one literal)
e) (A'+C)(A'+C')(A+B+C'D) (reduce to 4 literals)

Problem 2: Find the complement of the following functions

a) AB(C'D+CD')+A'B'(C'+D)(C+D')
b) (x+y'+z)(x'+z')(x+y)

Problem 3: Draw the following functions using OR gates and inverters only.

a) F = x'y' + x'z + y'z
b) G = (y+z')(x+y)(y'+z)

Problem 4: Repeat problem3 using AND gates and inverters only.

Problem 5: For the Boolean function F given in truth table, find the following:

w	x	y	z	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

a) F as a Minterm list using Σ notation
b) F as a Canonical sum
c) F as a Maxterm list using Π notation
d) F as a Canonical product
e) The complement of F as sum of minterms
f) Simplify F to a minimum number of literals

Problem 6: Convert the following expressions into 1) minimal sum of products 2) minimal product of sums and 3) sum of minterms. (Draw the corresponding truth table)

a) (AB+C)(B+C'D)
b) x'+x(x+y')(y+z')

Assignment 2
Solution

1) a) $wxy' + wy'z' + wx'z' = w(xy' + x'z' + y'z') = w(xy' + x'z')$
By consensus

b) $ABC + A'B + ABC' = AB(C + C') + A'B = AB + A'B = B$

c) $(BC' + A'D)(AB' + CD') = AB'BC' + AB'A'D + CD'BC' + CD'A'D$
$= 0$

d) $A'B(D' + C'D) + B(A + A'CD) = B(A'D' + A'C'D + A + A'CD)$
$= B(A'D' + A + A'D(C' + C)) = B(A + A'(D' + D)) = B(A + A') = B$

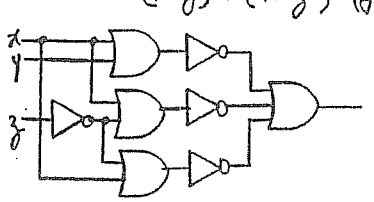
e) $(A' + C)(A' + C')(A + B + C'D) = (A' + CC')(A + B + C'D)$
$= A'(A + B + C'D) = A'B + A'C'D = A'(B + C'D)$

2) a) $[AB(C'D + CD') + A'B'(C' + D)(C + D')]' =$
$[(A' + B') + (C + D')(C' + D)][(A + B) + CD' + C'D]$

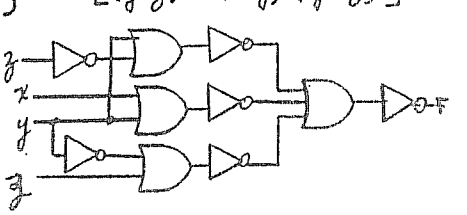
b) $(x + y' + z)(x' + z')(x + y) = x'yz' + xz + x'y'$

3)

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

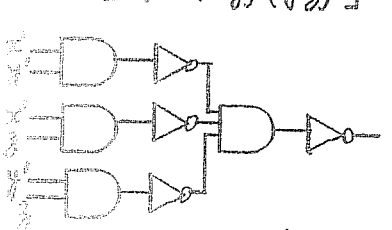


(b) $(y + z')(x + y)(y' + z)$
$= [(y + z')' + (x + y)' + (y' + z)']'$

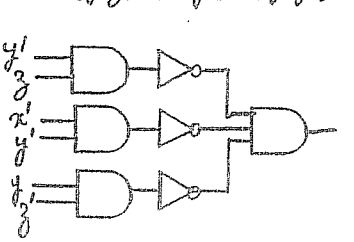


4)

(a) $F = x'y' + x'z + y'z$
$= [(x'y')'(x'z)'(y'z)']'$



(b) $F = (y + z')(x + y)(y' + z)$
$= (yz')'(x'y')'(yz')'$



oblem 5

a) $F = \Sigma_{w,x,y,z}(1,5,6,7,9,10,11,13,14,15)$

b) $F = w'x'y'z + w'xy'z + w'xyz' + w'xyz$
$+ wx'y'z + wx'yz' + wx'yz + wxy'z$
$+ wxyz' + wxyz$

c) $F = \Pi_{w,x,y,z}(0,2,3,4,8,12)$

d) $F = (w+x+y+z)(w+x+y'+z)(w+x+y'+z')(w+x'+y+z)$
$(w'+x+y+z)(w'+x'+y+z)$

e) $F' = \Sigma_{w,x,y,z}(0,2,3,4,8,12)$ (since minterms of F' are the maxterms of F)

f) $y'z(\underbrace{w'x' + w'x}_{w'} + \underbrace{wx' + wx}_{w}) + yz'(\underbrace{w'x + wx}_{x} + wx') + yz(\underbrace{w'x + wx}_{x} + wx') =$

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

$F = y'z + y(x+w)$ ... 5 literals.

Problem 6

a) $(AB+C)(B+C'D) = AB + ABC'D + BC + 0$

$= AB + BC$ (Sum of Products)

$= B(A+C)$ (Product of Sums)

truth table

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

$F = \Sigma_{A,B,C,D}(6,7,12,13,14,15)$

b) $F = x' + x(x+y')(y+z') = (\underbrace{x'+x}_{1})(x' + (x+y')(y+z'))$

$F = x' + xy + y'z'$

since $x' + xy = x' + y$ $\left(\underbrace{(x'+x)}_{1}(x'+y) = x'+y\right)$

Then

$F = x' + \underbrace{y + y'z'}_{} = x' + y + z'$ ← SOP and POS

$F = \Sigma_{x,y,z}(0,1,2,3,4,6,7)$

(since F = Maxterm 5)