CSE260
Assignment 02

This assignment must be hand-written. Show ALL steps in ALL questions.

Marks: 5+5+5 = 15

Graded Questions [1,2,3]:

1. Simplify the following boolean expressions to minimum number of literals:

(A⊕B)(C+D)(A⊙C)+(A+B)(C′+D)(A′+CC′)

$F(A,B,C,D) = (A \oplus B)(C+D)(A \odot C) + (A+B)(C'+D)(A'+CC')$

$= (AB' + A'B)(C+D)(AC + A'C') + (A+B)(C'+D)A'$

$= (AB' + A'B)(ACC + ACD + A'C'C + A'C'D) + (AA' + A'B)(C'+D)$

$= (AB' + A'B)(AC + ACD + A'C'D) + A'BC' + A'BD$

$= (AB' + A'B)(AC(1+D) + A'C'D) + A'BC' + A'BD$

$= (AB' + A'B)(AC + A'C'D) + A'BC' + A'BD$

$= AAB'C + AB'A'C'D + A'BAC + A'BA'C'D + A'BC' + A'BD$

$= AB'C + 0 + 0 + A'BC'D + A'BC' + A'BD$

$= AB'C + A'BD(C'+1) + A'BC'$

$= AB'C + A'BC' + A'BD$

2. Find the complement of the following expression:

(x' + y + z')(x + y')(x' + z)

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

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

3. Find out SOP and POS for the following [You cannot use truth table to solve these]:

F(V,W,X,Y,Z) = WY+WX+X'Y

You must show procedure for both. You must use distributive formula for POS.

∑(2, 3, 10, 11, 12, 13, 14, 15, 18, 19, 26, 27, 28, 29, 30, 31)

∏ (0,1,4,5,6,7,8,9,16,17,20,21,22,23,24,25)

SOP

F(V,W,X,Y,Z)=WY+WX+X′Y

= WY (V+V’)(X+X’)(Z+Z’) + WX (V+V’)(Y+Y’)(Z+Z’) + X’Y (V+V’)(W+W’)(Z+Z’)

= WY (VX+VX’+V’X+V’X’)(Z+Z’) + WX (VY+VY’+V’Y+V’Y’)(Z+Z’) + X’Y (VW+VW’+V’W+V’W’)(Z+Z’)

= WY (VXZ+VXZ′+VX′Z+VX′Z′+V′XZ+V′XZ′+V′X′Z+V′X′Z′) + WX (VYZ+VYZ′+VY′Z+VY′Z′+V′YZ+V′YZ′+V′Y′Z+V′Y′Z′) + X’Y(VWZ+VWZ′+VW′Z+VW′Z′+V′WZ+V′WZ′+V′W′Z+V′W′Z′)

= WYVXZ + WYVXZ' + WYVX'Z + WYVX'Z' + WYV'XZ + WYV'XZ' + WYV'X'Z + WYV'X'Z' +WXVYZ + WXVYZ' + WXVY'Z + WXVY'Z' + WXV'YZ + WXV'YZ' + WXV'Y'Z + WXV'Y'Z' +X'YVWZ + X'YVWZ' + X'YVW'Z + X'YVW'Z' + X'YV'WZ + X'YV'WZ' + X'YV'W'Z + X'YV'W'Z'

= VWXYZ + VWXYZ' + VWX'YZ + VWX'YZ' + V’WXYZ + V’WXYZ' + V’WX’YZ + V’WX'YZ' +VWXYZ + VWXYZ' + VWXY'Z + VWXY'Z' + V’WXYZ + V’WXYZ' + V’WXY’Z + V’WXY'Z' +VWX’YZ + VWX’YZ' + VW'X’YZ + VW'X’YZ' + V’WX’YZ + V'WX’YZ' + V'W'X’YZ + V'W'X’YZ'

=∑(11111,11110,11011,11010,01111,01110,01011,01010,11111,11110,11101,11100,01111,01110,01101,01100,11011,11010,10011,10010,01011,01010,00011,00010)

= ∑(31, 30, 27, 26, 15, 14, 11, 10, 31, 30, 29, 28, 15, 14, 13, 12, 27, 26, 19, 18, 11, 10, 3, 2)

= ∑(2, 3, 10, 11, 12, 13, 14, 15, 18, 19, 26, 27, 28, 29, 30, 31)

POS

F(V,W,X,Y,Z)=WY+WX+X′Y

= (WY+WX+X’)(WY+WX+Y)

= (WY+(W+X’)(X+X’)) (WY+(W+Y)(X+Y))

= (WY+W+X’) (WY+(W+Y)(X+Y))

= (W+X’+W)(W+X’+Y)((W+Y)(X+Y)+W)(W+Y)(X+Y)+Y)

= (W+X’)(W+X’+Y)(W+Y)(W+X+Y)(X+Y)

= (W+X’+VV’)(W+X’+Y+VV’)(W+Y+VV’)(W+X+Y+VV’)(X+Y+VV’)

=(V+W+X’)(V’+W+X’)(V+W+X’+Y)(V’+W+X’+Y)(V+W+Y)(V’+W+Y)(V+W+X+Y)(V’+W

+X+Y)(V+X+Y)(V'+X+Y)

=
(V+W+X'+Y)(V+W+X'+Y')(V'+W+X'+Y)(V'+W+X'+Y')(V+W+X'+Y+Z)(V+W+X'+Y+Z')
(V'+W+X'+Y+Z)(V'+W+X'+Y+Z')(V+W+X+Y)(V+W+X'+Y)(V'+W+X+Y)(V'+W+X'+Y)(
V+W+X+Y+Z)(V+W+X+Y+Z')(V'+W+X+Y+Z)(V'+W+X+Y+Z')(V+W+X+Y)(V+W'+X+Y)
(V'+W+X+Y)(V'+W'+X+Y)

=
(V+W+X'+Y+Z)(V+W+X'+Y+Z')(V+W+X'+Y'+Z)(V+W+X'+Y'+Z')(V'+W+X'+Y+Z)(V'+
W+X'+Y+Z')(V'+W+X'+Y'+Z)(V'+W+X'+Y'+Z')(V+W+X'+Y+Z)(V+W+X'+Y+Z')(V'+W
+X'+Y+Z)(V'+W+X'+Y+Z')(V+W+X+Y+Z)(V+W+X+Y+Z')(V+W+X'+Y+Z)(V+W+X'+Y+
Z')(V'+W+X+Y+Z)(V'+W+X+Y+Z')(V'+W+X'+Y+Z)(V'+W+X'+Y+Z')(V+W+X+Y+Z)(V+
W+X+Y+Z')(V'+W+X+Y+Z)(V'+W+X+Y+Z')(V+W+X+Y+Z)(V+W+X+Y+Z')(V+W'+X+Y
+Z)(V+W'+X+Y+Z')(V'+W+X+Y+Z)(V'+W+X+Y+Z')(V'+W'+X+Y+Z)(V'+W'+X+Y+Z')

= ∏ (00100, 00101, 00110, 00111,
10100,10101,10110,10111,00100,00101,10100,10101,00000,00001,00100,00101,10000,100
01,10100,10101,00000,00001,10000,10001,00000,00001,01000,01001,10000,10001,11000,
11001)
= ∏ (4,5,6,7,20,21,22,23,4,5,20,21,0,1,16,17,1,0,4,5,16,17,20,21,0,1,8,9,16,17,24,25)
= ∏ (0,1,4,5,6,7,8,9,16,17,20,21,22,23,24,25)

Ungraded Questions [4, 5, 6, 7]:

4. Simplify the following boolean expressions to minimum number of literals:
(A'B+B')BCC'+CB'C+D
= A'BBCC' + B'BCC' + CB'C + D
= 0 + 0 + B'C +D
= B'C + D

5. Draw the following expression using NAND gate only. You cannot use more than 2 inputs in the gates: F(A,B,C,D) = AB + C'D

Do it yourself.

6. Draw the following expression using NAND gate only. You cannot use more than 2 inputs in the gates: F(A,B,C,D) = AB + C'D

Do it yourself.

7. Find out SOP and POS for the following [You cannot use truth table to solve these]:

F(A,B,C,D,E) = A+ B’CD’

SOP

F(A,B,C,D,E) = A+ B’CD’

= A(B+B’)(C+C’)(D+D’)(E+E’) + B’CD’(A+A’)(E+E’)

= (AB + AB’) (CD+CD’+C’D+C’D’) (E+E’) + B’CD’ (AE+AE’+A’E+A’E’)

= (AB + AB’) (CDE+CD’E+C’DE+C’D’E +CDE’+CD’E’+C’DE’+C’D’E’) + ’ AEB’CD’+AE’B’CD’+A’EB’CD’+A’E’B’CD’

= ABCDE+ABCD’E+ABC’DE+ABC’D’E +ABCDE’+ABCD’E’+ABC’DE’+ABC’D’E’ + AB’CDE+AB’CD’E+AB’C’DE+AB’C’D’E +AB’CDE’+AB’CD’E’+AB’C’DE’+AB’C’D’E’+ AB’CD’E+AB’CD’E’+A’B’CD’E+A’B’CD’E’

= ∑(11111, 11101, 11011, 11001, 11110, 11100, 11010, 11000, 10111, 10101, 10011, 10001, 10110, 10100, 10010, 10000, 10101, 10100, 00101, 00100)

= ∑(00100, 00101, 10000, 10001, 10010, 10011, 10100, 10101, 10110, 10111, 11000, 11001, 11010, 11011, 11100, 11101, 11110, 11111)

=∑(4, 5, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31)

POS

F(A,B,C,D,E) = A+ B’CD’

= (A+B’) (A+CD’)

= (A+B’) (A+C) (A+D’)

= (A+B’+CC’) (A+C+BB’) (A+D’+BB’)

= (A+B’+C)(A+B’+C’) (A+C+B)(A+C+B’) (A+D’+B)(A+D’+B’)

= (A+B’+C+DD’)(A+B’+C’+DD’) (A+C+B+DD’)(A+C+B’+DD’)
(A+D’+B+CC’)(A+D’+B’+CC’)

= (A+B’+C+D)(A+B’+C+D’)(A+B’+C’+D)(A+B’+C’+D’)
(A+C+B+D)(A+C+B+D’)(A+C+B’+D)(A+C+B’+D’)
(A+D’+B+C)(A+D’+B+C’)(A+D’+B’+C)(A+D’+B’+C’)

= (A+B’+C+D+EE’)(A+B’+C+D’+EE’)(A+B’+C’+D+EE’)(A+B’+C’+D’+EE’)
(A+C+B+D+EE’)(A+C+B+D’+EE’)(A+C+B’+D+EE’)(A+C+B’+D’+EE’)
(A+D’+B+C+EE’)(A+D’+B+C’+EE’)(A+D’+B’+C+EE’)(A+D’+B’+C’+EE’)

=(A+B’+C+D+E)(A+B’+C+D+E')(A+B’+C+D’+E)(A+B’+C+D’+E')(A+B’+C’+D+E)(A+B’+C’+D+E')(A+B’+C’+D’+E)(A+B’+C’+D’+E')(A+B+C+D+E)(A+B+C+D+E')(A+B+C+D’+E)(A+B+C+D’+E')(A+B’+C+D+E)(A+B’+C+D+E')(A+B’+C+D’+E)(A+B’+C+D’+E')(A+B+C+D’+E)(A+B+C+D’+E')(A+B+C’+D’+E)(A+B+C’+D’+E')(A+B’+C+D’+E)(A+B’+C+D’+E')(A+B’+C’+D’+E)(A+B’+C’+D’+E')

= ∏(01000,01001,01010,01011,01100,01101,01110,01111,00000,00001,00010,00011,01000,01001,01010,01011,00010,00011,00110,00111,01010,01011,01110,01111)

= ∏(8, 9, 10, 11, 12, 13, 14, 15, 0, 1, 2, 3, 8, 9, 10, 11, 2, 3, 6, 7, 10, 11, 14, 15)

= ∏(0, 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)