Name:___Markus Afonso______

MATH 1310 – *Technical Math for IT*

Set:___________C____________

ASSIGNMENT 5

Due: Start of the class, Oct 31 (Set B and Set C), Nov 3 (Set A)

This is how I mark this assignment:

50 percent: I scan all the questions to see if they are solved or not.

50 percent: I select a few parts randomly and mark them in detail.

24 marks. Complete all work on separate pages. Work must be clear and complete to receive full marks.

Consider the Boolean expression

$$F = (x+z)' \oplus (xy')' + (x+y)' z$$

a) [3] Construct the truth table for F, without any simplification

x	y	z	x'	y'	z'	$x+z$	$(x+z)'$	xy'	$(xy')'$	$(x+y)$	$(x+y)'$	$(x+y)'z$	$(x+z)'\oplus(xy')'$	$(x+z)'\oplus(xy')'+(x+y)'z$
0	0	0	1	1	1	0	1	0	1	0	1	0	0	0
0	0	1	1	1	0	1	0	0	1	0	1	1	1	1
0	1	0	1	0	1	0	1	0	1	1	0	0	0	0
0	1	1	1	0	0	1	0	0	1	1	0	0	1	1
1	0	0	0	1	1	1	0	1	0	1	0	0	0	0
1	0	1	0	1	0	1	0	1	0	1	0	0	0	0
1	1	0	0	0	1	1	0	0	1	1	0	0	1	1
1	1	1	0	0	0	1	0	0	1	1	0	0	1	1

b) [2] Find canonical SOP and POS forms using the truth table in part a)

x	y	z	F	
0	0	0	0	$(x + y + z)$
0	0	1	1	$x'y'z$
0	1	0	0	$(x + y' + z)$
0	1	1	1	$x'yz$
1	0	0	0	$(x' + y + z)$
1	0	1	0	$(x' + y + z')$
1	1	0	1	xyz'
1	1	1	1	xyz

SOP: $x'y'z + x'yz + xyz' + xyz$

POS: $(x + y + z)(x + y' + z)(x' + y + z)(x' + y + z')$

c) [2] Create Karnaugh map corresponding to the truth table in part a)

z \ xy	00	01	11	10
0	0	0	1	0
1	1	1	1	0

d) [4] Find optimal SOP and POS using the karnaugh map

z \ xy	00	01	11	10
0	0	0	1	0
1	1	1	1	0

$$\begin{cases} x = 0 \\ y = \text{any} \\ z = 1 \end{cases} \quad x'z$$

$$\Rightarrow \quad xy + x'z$$

$$\begin{cases} x = 1 \\ y = 1 \\ z = \text{any} \end{cases} \quad xy$$

z \ xy	00	01	11	10
0	0	0	1	0
1	1	1	1	0

$$\begin{cases} x = 0 \\ y = \text{any} \\ z = 0 \end{cases} \quad (x + z)$$

$$\Rightarrow \quad (x+z)(x'+y)$$

$$\begin{cases} x = 1 \\ y = 0 \\ z = \text{any} \end{cases} \quad (x' + y)$$

e) [6] Starting from original expression, use postulates/theorems of Boolean algebra to reach optimal SOP form you found in section d)

$(x+z)' \oplus (xy')' + (x+y)'z$

let $(x+z)' = a$, $(xy')' = b$

$a \oplus b$

$ab' + a'b + (x+y)'z$

$[(x+z)'][\cancel{((xy')')'}] + [\cancel{((x+z)')'}][(xy')'] + (x+y)'z$

$(x'z')(xy') + (x+z)(x'+y'') + (x'y')z$ T15a, T15b

$\overset{0}{\cancel{x'}z'\cancel{x}y'} + (x+z)(x'+y) + x'y'z$

$\overset{0}{\cancel{xx'}} + xy + zx' + zy + x'y'z$ L8a

$xy + zy + zx'(\overset{1}{\cancel{1+y'}})$

$xy + zy + zx'(1)$

$xy + zy(1) + zx'$ T10a

$xy + zy(x+x') + zx'$ T12b

$xy + zyx + zyx' + zx'$ L8a

$xy(\overset{1}{\cancel{1+z}}) + zx'(\overset{1}{\cancel{y+1}})$ L8a

$xy(1) + zx'(1)$

$xy + zx'$

f) [4] Starring from optimal SOP form, use postulates/theorems of Boolean algebra to reach optimal POS from

$$xy + zx'$$

$$xy(1) + zx'(1)$$

$$xy(1+z) + zx'(1+y) \qquad L8a$$

$$xy + xyz + zx' + zx'y$$

$$xy + zx' + xyz + zx'y$$

$$xy + zx' + zy\overset{1}{(\cancel{x+x'})}$$

$$xy + zx' + zy + 0$$

$$xy + zx' + zy + xx'$$

$$\underline{xx'} + \underline{xy} + \underline{zx'} + \underline{zy}$$

$$(x+z)(x'+y) \qquad L8a$$

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

g) [2] Construct truth table for optimal SOP and POS form

x	y	z	x'	xy	$x'z$	$(x+z)$	$(x'+y)$	$xy+x'z$	$(x+z)(x'+y)$
0	0	0	1	0	0	0	1	0	0
0	0	1	1	0	1	1	1	1	1
0	1	0	1	0	0	0	1	0	0
0	1	1	1	0	1	1	1	1	1
1	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	1	0	0	0
1	1	0	0	1	0	1	1	1	1
1	1	1	0	1	0	1	1	1	1

h) [1] Do they match with the original truth table in part a)? what is the conclusion?

They are equal and match the original truth table ∴ proves that POS and SOP forms are equal eventhough they look different.