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ECS 154A
DUE: 01/18/16

HOMEWORK #1

WRITTEN

1.) Use Boolean Algebra to prove that

$(\bar{A} * B * \bar{C}) + (\bar{A} * B * C) + (A * \bar{B} * C) + (A * B * \bar{C}) + (A * B * C) =$
$(A+B) * (B+C)$

$B(\underbrace{\bar{A}\bar{C} + \bar{A}C + A\bar{C} + AC}_{1}) + (A\bar{B}C) = (A+B)(B+C)$

$= (A+B)(B+C)$

$B + (A\bar{B}C) = (A+B)(B+C)$

$B + \underbrace{\bar{B}}_{B}(AC) = B + (AC)$

$B + AC = B + AC$

LHS = RHS ✓

∴ equivalent

2.) Prove that A XOR B = $A * \bar{B} + \bar{A} * B$

→ Truth Table

A	B	$\bar{A}$	$\bar{B}$	$A*\bar{B}$	$\bar{A}*B$	$A*\bar{B} + \bar{A}*B$	$A \oplus B$
0	0	1	1	0	0	0	0
0	1	1	0	0	1	1	1
1	0	0	1	1	0	1	1
1	1	0	0	0	0	0	0

tautology ≈ equivalent

XOR ($\oplus$) = cannot be same

i.e. $0 \oplus 0 = 0$ $\quad 1 \oplus 0 = 1$

$0 \oplus 1 = 1$ $\quad 1 \oplus 1 = 0$

∴ A XOR B = $A * \bar{B} + \bar{A} * B$

via truth table ✓

3.) Write function that represents following circuit. Do not simplify

$(AB\bar{C}) + [(\bar{D}(AB\bar{C})) + (((AB\bar{C})^{-})D)] * (\overline{AD}) + (\bar{D}+B)$ (simplified)

$f(x) = \boxed{(AB\bar{C}) \overline{\oplus} D * (\overline{AD}) + (\bar{D}+B) = F}$

$AB\bar{C}$ XNOR D * NOT(AD) + $(\bar{D}+B) = F$

4.) Given the following truth table.

4.1) Write function in SOP form. Do not simplify.

SOP = sum of products, minterms

- want all 1's output

$= m_0 + m_1 + m_2 + m_5 + m_6$,

where: $m_0 = (\bar{A}\bar{B}\bar{C})$ $\quad m_5 = (A\bar{B}C)$

$m_1 = (\bar{A}\bar{B}C)$ $\quad m_6 = (AB\bar{C})$

$m_2 = (\bar{A}B\bar{C})$

so:

$$f(x) = \boxed{(\bar{A}\bar{B}\bar{C}) + (\bar{A}\bar{B}C) + (\bar{A}B\bar{C}) + (A\bar{B}C) + (AB\bar{C})}$$

4.2) Write function in POS form. Do not simplify.

POS = product of sums, maxterms

- want all 0's output

$= M_3 + M_4 + M_7$

where: $M_3 = (A + \bar{B} + \bar{C})$

$M_4 = (\bar{A} + B + C)$

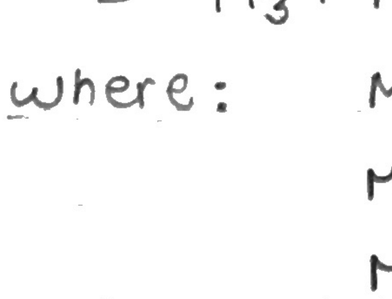
$M_7 = (\bar{A} + \bar{B} + \bar{C})$

so:

$$f(x) = \boxed{(A + \bar{B} + \bar{C}) * (\bar{A} + B + C) * (\bar{A} + \bar{B} + \bar{C})}$$

5.) most simplified SOP & POS form for ea. of the functions.

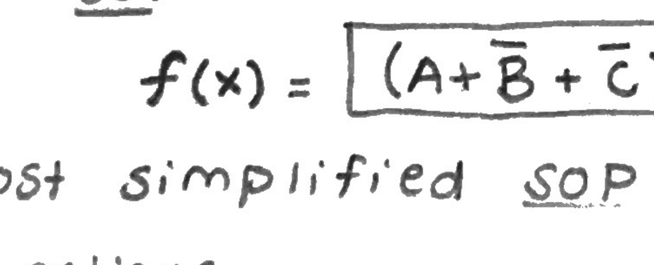
5.1) $m_0 + m_1 + m_2$



SOP = $(\overline{X_1} * \overline{X_0})$

POS = $(\overline{X_1} + \overline{X_0})$

5.2) $M_0 * M_3 * M_4 * M_7$



SOP = $(X_1 \cdot \overline{X_0}) + (\overline{X_1} \cdot X_0)$

POS = $(X_1 + X_0) * (\overline{X_1} + X_0)$

5.3) $m_4 + m_5 + m_7 + m_{12} + m_{13} + m_{15}$ $\quad 2^4 = 16$

x_1x_0 \ x_3x_2	00	01	11	10
00	0 (0)	1 (4)	1 (12)	0 (8)
01	0 (1)	1 (5)	1 (13)	0 (9)
11	0 (3)	1 (7)	1 (15)	0 (11)
10	0 (2)	0 (6)	0 (14)	0 (10)

$\underline{SOP} = (X_0 * X_2) + (\overline{X_1} * X_2)$

$\underline{POS} = X_2 * (\overline{X_1} + X_0)$

- POS is SOP essentially but, product of sums w/ X_2 factored out

5.4) $m_0 + m_3 + m_4 + m_8 + D_2 + D_5 + D_7 + D_{10} + D_{13} + D_{15}$

x_1x_0 \ x_3x_2	00	01	11	10
00	1 (0)	1 (4)	0 (12)	1 (8)
01	0 (1)	DC (5)	DC (13)	0 (9)
11	1 (3)	DC (7)	DC (15)	0 (11)
10	DC (2)	0 (6)	0 (14)	DC (10)

$\underline{SOP} = (\overline{X_0} * \overline{X_2}) + (\overline{X_3} * \overline{X_1} * \overline{X_0}) + (\overline{X_3} * \overline{X_2} * X_1)$

$\underline{POS} = (\overline{X_2} + \overline{X_3}) * (\overline{X_0} + X_1) * (\overline{X_3} + \overline{X_0}) * (\overline{X_2} + \overline{X_1})$

5.5) $m_1 + m_3 + m_7 + m_9 + m_{11} + m_{15} + m_{17} + m_{19} + m_{25} + m_{27} + D_4 + D_6 + D_{12} + D_{14} + D_{16} + D_{18} + D_{20} + D_{22} + D_{24} + D_{26} + D_{28} + D_{30}$

x_1x_0 \ x_3x_2	00	01	11	10
00	0 (0)	DC (4)	DC (12)	0 (8)
01	1 (1)	0 (5)	0 (13)	1 (9)
11	1 (3)	1 (7)	1 (15)	1 (11)
10	0 (2)	DC (6)	DC (14)	0 (10)
00	DC (16)	DC (20)	DC (28)	DC (24)
01	1 (17)	0 (21)	0 (29)	1 (25)
11	1 (19)	0 (23)	0 (31)	1 (27)
10	DC (18)	DC (22)	DC (30)	DC (26)

$\underline{SOP} = (X_0 * \overline{X_2}) + (X_2)$

$\underline{POS} = (\overline{X_2} + X_1) * (X_2 + \overline{X_1}) * (\overline{X_2} + \overline{X_0})$